2010 INTERIM REPORT FOR THE LIMERICK GENERATING STATION WATER SUPPLY MODIFICATION DEMONSTRATION PROJECT AND WADESVILLE MINE POOL WITHDRAWAL AND STREAMFLOW AUGMENTATION DEMONSTRATION PROJECT

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EXECUTIVE SUMMARY

This interim report presents the results for the eighth year, 2010, of the Limerick Generating Station Water Supply Modification Demonstration Project and Wadesville Mine Pool Withdrawal and Streamflow Augmentation Demonstration Project (Demonstration). The purpose of the Demonstration has been to evaluate the use of water pumped from the Wadesville Mine Pool at Pottsville and water released from Still Creek Reservoir at Tamaqua to augment the flow of the Schuylkill River for consumptive cooling makeup water by Exelon's Limerick Generating Station (LGS) some 75 miles downriver near Pottstown. Low Schuylkill River flows were experienced during much of the 2010 Demonstration period contrary to the high flows during the 2009 Demonstration. As a result, the Wadesville Mine Pool was used for augmentation on 53 days and Still Creek Reservoir released on 60 days during the Demonstration period.

The Demonstration was governed by Docket Revision 12 which was approved by the Delaware River Basin Commission (DRBC) in October 2004. This Revision allowed the Demonstration to extend through 2008. Resolutions by the DRBC have extended the Docket, pending approval of a revised Docket. A resolution to extend Docket Revision 12 through December 2010 or until Docket Revision 13 is approved was granted by the DRBC commissioners on December 9, 2009.

The main objectives of the first two years of the Demonstration had been to show that water pumped from the Wadesville Mine Pool and released from Still Creek Reservoir (for non-emergency use) can provide a viable supply of water to the Schuylkill River for consumptive use by LGS, allow a corresponding reduction in the amount of water withdrawn from the Delaware River via the LGS Water Diversion System, and have positive or insubstantial ecological effects. For 2005 through 2010 the Project sought to also demonstrate that withdrawal of unaugmented consumptive cooling makeup water from the Schuylkill River by LGS would not have a substantial effect on downstream dissolved oxygen (DO) when ambient river temperatures exceed 59^{o}F and river flows at the USGS Pottstown Gage are above 560 CFS.

The eighth year of the Demonstration was conducted from April 15 through November 30, 2010 following an Operation and Monitoring Plan approved by the DRBC as part of Docket Revision 12. This Plan provides rules for conducting the Demonstration, including operational as well as environmental monitoring responsibilities. The environmental monitoring focused on water quality and aquatic biology.

Several watercourses conveyed water to LGS and were monitored during the Demonstration Project. East Norwegian/Norwegian Creek and the Schuylkill River conveyed Wadesville Mine Pool water. The East Branch Perkiomen Creek (EBPC) and Perkiomen Creek conveyed Delaware River water via the LGS Water Diversion System. In addition, water from Still Creek Reservoir, located near Tamaqua, was conveyed to the Schuylkill River by way of Still Creek and the Little Schuylkill River. Monitoring was performed in the Schuylkill River downstream of LGS to determine if the water withdrawals at LGS would effect downstream DO levels.

The following is a summary list of the environmental monitoring that was conducted:

- Wadesville Pool water quality
- Schuylkill River flow and rainfall
- Lower Schuylkill River DO and other water quality measures
- Pottstown Water Treatment Plant and Pennsylvania American intake water quality
- East Norwegian Creek water quality

- Upper Schuylkill River biology and water quality
- Still Creek Reservoir discharge rate and water quality
- Little Schuylkill River biology, flow, and water quality
- Perkiomen Creek water quality
- East Branch Perkiomen Creek water quality and biology

Wadesville Mine Pool water was pumped for LGS augmentation into East Norwegian/Norwegian Creek on 53 days during the 2010 Demonstration.

The mine water was sampled monthly for several water quality parameters, including several constituents listed in the Mine's NPDES permit. All measurements were within the ranges expected based on the recent Wadesville Mine Pool monitoring data. Over the 8 years of the Demonstration, total dissolved solids (TDS) and pH varied within a relatively narrow ranges from year to year and, on average, have been fairly stable. Specific conductance was comparable to previous years but has varied from year to year. The concentration of manganese and iron was within the range of values reported over the previous 7 years. The data for all parameters remained in an expected range of variability with no cause for concern.

Biological resources in the Schuylkill River upstream and downstream of the Norwegian Creek confluence were monitored during May, August, and November. The fish communities at both locations contained a mixture of cool and warmwater species, with blacknose dace, creek chub, and white sucker most abundant. A mixture of wild and hatchery-reared rainbow, brown, and brook trout were collected from both locations with greater numbers collected downstream. Low numbers of macroinvertebrate taxa were collected at both Schuylkill River locations, with more individuals being present downstream than upstream. The results in 2010, with the use of the Mine Pool, were comparable to those reported for 2003 through 2009 which indicated no negative impacts to either the fish or macroinvertebrate communities within the Schuylkill River at the downstream sample location. These findings support the continued use of the Wadesville Mine Pool.

Dissolved oxygen concentrations were monitored at the LGS Intake, Pennsylvania American Intake, Black Rock Dam, and Norristown Pool from April through November and at Vincent Dam, from April to October. The data indicate that fluctuations in DO were not correlated to changes in Schuylkill River flow associated with water withdrawal at LGS. River discharge was below 1,000 CFS for 105 days during the Demonstration and reached a low of 346 CFS on September 16. The instantaneous minimum DO concentrations at the four Exelon monitoring stations did not drop below the water quality standard (4.0 mg/l) at any time during the Demonstration period.

Schuylkill River flow was augmented by discharges from Still Creek Reservoir for 60 days during the Demonstration. Total volume released was 950.6 MG from May 28 to September 27, which temporarily lowered the Reservoir water surface elevation by 11.3 feet.

The Bradshaw Reservoir pumped water to the EBPC to maintain a minimum stream flow of approximately 10 CFS throughout the Demonstration. Water quality monitoring performed in the EBPC indicated no adverse impact due to reduced water flow from Bradshaw. Likewise, benthic macroinvertebrate and fish monitoring in EBPC indicated similar community composition prior to and during the Demonstration.

The eighth year of the Demonstration Project again showed that the Wadesville Mine Pool and Still Creek Reservoir are operationally reliable and environmentally suitable sources of consumptive cooling makeup water for LGS. Both augmentation sources were used extensively during the 2010 Demonstration. The biological community was similar in 2010 to the previous years of the Demonstration and this is important evidence that confirms the augmentation sources as environmentally sound.

In addition, the expanded Demonstration showed that withdrawal from the Schuylkill River of the consumptive water needed by LGS without the restriction related to ambient river temperature did not cause downstream dissolved oxygen to fall below Water Quality Standards. The results from 2005 thru 2010 support elimination of the temperature restriction so that LGS can withdraw the full amount of consumptive makeup water needs with no augmentation until river flows decrease to below 560 CFS as provided for in Docket Revision 12.

In 2010, the Demonstration Project resulted in a contribution of about $215,480 to the Restoration and Monitoring Fund. The Fund supports environmental restoration projects that target water quality improvements within the Schuylkill Basin.

Projects awarded with monies from the 2009 fund included:

- $52K to the Berks County Conservancy for agricultural Best Management Practices (BMPs) on the Martin Farm in the Saucony Creek Watershed.
- $40K to Lower Providence Township for five stormwater basin retrofits in the Perkiomen Creek Watershed.
- $80K to the Schuylkill Headwaters Association for the Glendower Breach Restoration Project. The project restored a pond breach along the West Branch of the Schuylkill River, preventing legacy sediments from entering the stream and negatively affecting water quality.

These projects resulted from a stimulus of $172K from the Restoration and Monitoring Fund.

Based on the past 8 years of the Demonstration, the data supports:

- Long term approval of augmentation from Wadesville Mine Pool,
- Long term approval of augmentation from Still Creek Reservoir,
- Long term elimination of the 59 °F augmentation requirement,
- Reduction of the Schuylkill River low flow trigger point, and
- Year round maintenance of a 10 CFS minimum flow limit in the East Branch Perkiomen Creek
- Continuation of scheduled recreational releases in the East Branch of Perkiomen Creek.

1.0 INTRODUCTION

1.1 Overview of the Demonstration Project

In June 2003, Exelon Generation Company LLC (Exelon) received approval from the DRBC via Revision 11 to Docket D-69-210 CP (Final) to conduct a Demonstration Project involving supplementing the flow of the Schuylkill River by pumping water from the Wadesville Mine Pool into the headwaters of the Schuylkill River at Pottsville (Figure 1.1-1). The intent of the project was to augment the flow of the Schuylkill River during the seasonal period associated with low river flow and when river temperatures exceed 59^{o}F, and thereby increase the time that LGS would be allowed to withdraw consumptive cooling water from the river. This increase in the use of the Schuylkill River for consumptive cooling use at LGS would allow a corresponding reduction in the amount of water diverted for the same purpose from the Delaware River into the East Branch Perkiomen Creek (EBPC) via the LGS Water Diversion System.

A DRBC-approved Operating and Monitoring Plan was implemented to govern the conduct of the Demonstration and verify that use of the mine water or Still Creek Reservoir water would not cause unacceptable environmental impact. The Delaware River water diversion system was maintained in operation during the Demonstration, in accordance with the requirements of the approved Operating Plan, so that it could provide the full amount of water required by LGS if necessary. In addition, the Docket revision allowed for releases from Tamaqua's Still Creek Reservoir (subject to its yield curve limitations) at any time rather than only during emergency conditions.

Initially, the Demonstration was scheduled to extend over only one (2003) pumping season. However, due primarily to abnormally high ambient streamflow conditions in the watershed which made it difficult, if not impossible, to definitively determine if environmental impacts would develop, the Demonstration was extended to a second (2004) season in order to provide additional assurance that the predicted negligible environmental effects would occur from the use of the mine pool source. Again, abnormally high ambient flow conditions prevailed during the 2004 pumping season.

In mid-2004 Exelon applied to the DRBC for approval to extend and expand the Wadesville and Still Creek Demonstration Project to also include suspension of the temperature criterion and instead rely on the Schuylkill River low flow threshold of 560 CFS to trigger flow augmentation. In October 2004, the DRBC approved Revision 12 to the Docket which allowed the expanded Demonstration to continue through 2007 with an option to extend through 2008 to demonstrate, under controlled conditions, that withdrawal of Schuylkill River water would not cause adverse impact when ambient water temperatures exceed 59^{o}F, the maximum temperature at which unaugmented withdrawals were permitted under Docket Revision 11. Docket Revision 12 has been extended through December 31, 2010 or until Revision 13 is approved via a resolution which was approved by the DRBC on December 9, 2009. In addition, the project intends to show that no adverse impacts will occur in the East Branch Perkiomen Creek due to replacing the minimum flow requirement of 27 cubic feet per second (CFS) after initiation of pumping at Bradshaw Reservoir with the 10 CFS minimum flow requirement.

A significant feature of the Demonstration Project which was added in Revision 12 of the Docket is the creation of a Restoration and Monitoring Fund (RMF). Exelon will contribute to the RMF based on the quantities of consumptive cooling water that are not required to be augmented. The objective is to use the RMF to support restoration projects which can make a significant improvement in water quality within the Schuylkill River Basin.

Interim reports for each Demonstration period have been issued annually. The data and analyses for the eighth Demonstration period which extended from April 15 to November 30, 2010 are contained in this report.

1.2 Basis for the Project

At full power operation, LGS's per unit consumptive cooling use rates are a nominal 17.5 million gallons per day (MGD) average and could use up to a permitted 21 MGD maximum. These are equivalent to approximately 24,300 gallons per minute (GPM) average and 29,200 GPM maximum for the two units at LGS. The anticipated maximum mine pool yield was approximately 9,000 to 10,000 GPM, which represents approximately 40 percent of the average consumptive cooling makeup requirement for LGS. The balance of the makeup requirement would be provided from Tamaqua's Still Creek Reservoir and the diversion system from the Delaware River. Exelon would operate the mine pool as an underground reservoir with pumping over an approximately 6-month period followed by six months of recharge. By using this plan, the pool would be managed as a renewable resource.

The primary drivers for identifying one or more additional sources of consumptive cooling makeup were:

- To expand the source water options available to LGS (thus providing increased reliability and operational flexibility),
- Provide net environmental benefits to the Delaware River Basin, and
- Reduce Exelon's costs associated with the operation and maintenance of the diversion system.

The project is compatible with Pennsylvania's policy to encourage the use of a mine water source for cooling water purposes in the generation of electricity and, as such, was actively supported by the Pennsylvania Department of Environmental Protection (PADEP). The policy is intended to address the problems associated with the release of acid mine drainage from abandoned, inactive, or underutilized coal mines, which has caused severe adverse effects on the water quality and beneficial uses of Pennsylvania's rivers and streams. This pollution limits the ability of the streams to support abundant aquatic life and recreational activities, and transforms a natural asset into a liability.

The process of searching for a viable water source within the Schuylkill River Basin began in 2002 and led to Wadesville being selected as the leading candidate. The search for alternate water sources found that only mine waters were capable of reliably supplying the sizeable quantities of water required. The Wadesville Mine Pool was the most advantageous source of augmentation water for the Demonstration Project in comparison to other sources considered. Among the reasons that Wadesville was selected were:

- Significant capital improvements were not required to commence pumping in 2003.
- The mine pool water is naturally high in alkalinity, which improves the buffering capacity of the receiving stream.

- The mining company (Reading Anthracite Company or RAC) was willing to commit resources and enter into a binding contract for providing the service of water pumping.
- The discharge had an approved NPDES permit and met its conditions.

2.0 DESCRIPTION OF THE WADESVILLE MINE SITE

2.1 Project Setting

The productive coal areas in the anthracite region of Pennsylvania are in four distinct fields: Northern, Eastern Middle, Western Middle and Southern. The Southern anthracite field, in which the Wadesville Mine is situated, has an area of about 200 square miles. This field extends about 70 miles in the east-west direction and measures 1 to 6 miles wide in Carbon, Schuylkill, Dauphin, and Lebanon Counties from Jim Thorpe and the Lehigh River on the east to the Susquehanna River on the west. The Wadesville mining operation is in the Beechwood-Wadesville-Pine Forest Basin of the Southern Middle Anthracite Field in Schuylkill County (near Pottsville), Pennsylvania, and geologically, in the Llewellyn Formation.

The anthracite region has a long history of extensive deep shaft mining since the early 1800s and surface (strip) mining since the 1940s. These past and ongoing mining operations allow surface water to enter the mine workings and accumulate. The water is impounded in underground pools and in abandoned stripping excavations. Barrier pillars separate the mine pools from each other. The impounded water has to be pumped to the surface or it overflows by gravity through drainage tunnels or breaches upon reaching an elevation that varies from pool to pool. There are approximately 31 major underground pools in the Southern field, including Wadesville, plus a larger number of surface pools from stripping operations.

2.2 Wadesville Mine Pool Water Quality

Mining operations allow moisture and air to come into contact with sulfur-bearing minerals (iron sulfides, pyrite, and marcasite) that naturally occur in this region. As a result, chemical reactions take place which lead to the formation of sulfuric acid. Most of the water in the deep mine pools becomes highly acidic and, if allowed to drain into surface waters, the acid mine drainage or AMD becomes an appreciable source of stream pollution. The water in the Wadesville Mine Pool is an exception in that it has a pH in the neutral range (typically 6 to 8) and a moderate level of alkalinity. These characteristics made this source of augmentation water much superior in comparison to several other candidate mine pool sources.

Historically prior to the Demonstration, the acidity levels of the Pool water were negligible [<1 milligram per liter (mg/l)] and the alkalinity levels were on the order of 300-400 mg/l. Specific conductance levels ranged about 1,500-1,800 micromhos per centimeter (µmhos/cm), sulfate 500-700 mg/l, and water temperatures 55-60°F.

2.3 Wadesville Mine Works History

The deep mine operation at the Wadesville Colliery was discontinued in 1930, and with the cessation of pumping, the water pool within the mine increased to such a high level that the overflow discharged into Mill Creek at Saint Clair from an abandoned Saint Clair Colliery shaft. In 1949, the now RAC started stripping operations for recovery of coal and installed deep well pump equipment to discharge excess mine water into the Schuylkill River via Norwegian Creek. RAC has continued stripping operations with several interruptions up to the present time period. RAC’s future plans to continue mining at Wadesville are not clearly defined. However, without continued pumping, the mine pool elevation would increase until it overflows into Mill Creek.

The potential for this overflow is of concern because of development that has occurred in Saint Clair in the vicinity of the overflow site since the last period of overflow.

2.4 Mine Dewatering Facilities

The existing pump house, which is located at the Wadesville vertical borehole shaft approximately ¼-mile from the open pit, contains pumping equipment used for dewatering of the mine to support present-day surface mining operations. The top of the shaft is at elevation (El) 782 feet above Mean Sea Level (MSL) and the elevation of the bottom of the pool is at approximately 85 feet MSL. The overflow elevation through an existing pipe at the abandoned Saint Clair shaft is at El 732 feet MSL. A federal government agency estimate of the water volume in the workings in 1953 was 3.4 billion gallons.

Two vertical turbine pumps are installed in the Wadesville mineshaft. Together they have a maximum design discharge rate in the range of 9,000 to 10,000 GPM. Note that the design pumping rates may have increased because both pumps had major overhauls since the Demonstration began. Prior to the Demonstration, the pumps operated periodically to maintain the water level at approximately 450 feet (El 332 feet MSL) below the surface to support active strip mining. In the first pumping season the bottoms of the pumps were approximately 500 feet (El 282 feet MSL) below the surface. During 2004 one of the pumps was refurbished and lowered to 600 feet (El 182 feet MSL) below the surface to gain access to additional pool volume. In 2005 and 2006, both pumps were used as needed and in 2007 through 2010 only the deep pump was operated. Currently the shallow pump is in need of repair and is not available for use.

The discharge path from the pump house to the Schuylkill River is initially open-channel flow via a dry swale which leads to what is locally known as East Norwegian Creek until it reaches the northern end of Pottsville. At this point, a subsurface conduit channels the flow through Pottsville until it daylights on the southern end where it immediately discharges to the Schuylkill River.

3.0 THE DEMONSTRATION PROJECT

3.1 Operation Plan

Part I of the DRBC-approved Demonstration Operation and Monitoring Plan, which was included as Attachment 3 to Docket Revision 12, provides rules for continuing the Demonstration of stream flow augmentation using the Wadesville Pool and Still Creek Reservoir and for increased withdrawals from the Schuylkill River for some or all of the consumptive cooling makeup at LGS after the 59^{o}F temperature restriction is reached, as long as the Schuylkill River flow at Pottstown is higher than a daily average of 560 CFS (or 530 CFS if only one LGS unit is operating). It identifies the plan of operation; responsibilities of Exelon, RAC, and DRBC during the Demonstration Project; and specifies the pumping equipment configuration, evaluation criteria, and reporting requirements. In addition, it describes the Restoration and Monitoring Fund that LGS has established to fund projects designed to improve water quality within the Schuylkill River Basin.

3.2 Monitoring Plan

Part II of the Plan specifies the parameters to be monitored, the methodologies, the frequency, and locations to be sampled in order to provide the data necessary to assess the impacts of the mine water and reservoir releases on Norwegian Creek and the Schuylkill River, the increased consumptive withdrawals from the Schuylkill River at LGS, and the decreased diversion flows to the East Branch Perkiomen Creek. In short, the monitoring plan was designed to measure water quality and aquatic biological impacts to these waters.

3.3 Affected Surface Waters

Several watercourses conveyed water to LGS during the Demonstration Project. These include East Norwegian/Norwegian Creek, tributary to the Schuylkill River at Pottsville, and the main stem Schuylkill River. Other surface waters were affected by the Demonstration Project as well. Water from Still Creek Reservoir, a public water supply operated by the Tamaqua Water Authority, was discharged via Still Creek to the Little Schuylkill River, which joins the Schuylkill River at Port Clinton some 15 miles downriver of Pottsville. The East Branch Perkiomen Creek and Perkiomen Creek, components of the LGS Water Diversion System Project, received reduced amounts of water from the Bradshaw Reservoir.

Wadesville Mine Pool water was discharged to a swale that ordinarily would be dry, except when it conveys surface runoff in wet periods. The swale connects to East Norwegian Creek, which mostly flows within a constructed channel to the north part of Pottsville where it enters a long underground conduit. Within this conduit, East Norwegian Creek joins with West Norwegian Creek to form Norwegian Creek, which flows through the conduit to the Schuylkill River in Pottsville (Figure 4.5-1). LGS withdraws cooling water from the Schuylkill River approximately 75 miles downriver of Pottsville.

The East Branch Perkiomen Creek receives water from the Point Pleasant Pumping Station on the Delaware River via the intermediate Bradshaw Reservoir. This water is discharged via pipeline to the headwaters of East Branch Perkiomen Creek and then flows to the Perkiomen Creek. From here, the water continues downstream to the Perkiomen Pumping Station at Graterford for conveyance by pipeline to LGS or, if only the minimum flow of approximately 10 CFS is being released, it is allowed to continue flowing down the Perkiomen Creek to the Schuylkill River. This system for supply of consumptive use make-up water from the Delaware River to LGS is known as the LGS Water Diversion System Project.

4.0 MONITORING PROGRAM AND RESULTS

During operation of the Demonstration Project, the following data collection and monitoring was conducted in order to assess potential environmental impacts:

- Wadesville Pool water quality
- Schuylkill River flow and rainfall
- Lower Schuylkill River dissolved oxygen (DO), pH, and temperature
- Pottstown Water Treatment Plant and Pennsylvania American Intake water quality
- East Norwegian Creek water quality
- Upper Schuylkill River biology and water quality
- Still Creek Reservoir discharge rate and water quality
- Little Schuylkill River biology, flow rates, and water quality
- Perkiomen Creek water quality
- East Branch Perkiomen Creek biology and water quality

These programs encompassed measurement of a wide range of parameters at differing frequencies. A description of each program element and results obtained during the Demonstration Project follow.

4.1 Wadesville Pool Water Level, Discharge Rate and Quality

Pumping of Wadesville Mine Pool water into East Norwegian Creek for LGS augmentation started on June 30 and ended on September 29, 2010. However, during this time there were two intervals, July 8 to August 4 and August 17 to August 24, when pumping was not required for LGS augmentation. The daily total volume pumped, totalized volume pumped, and the resulting change in mine pool water level were measured. In addition, measurements of conductivity were made in the pump discharge flow at the pumphouse.

During the entire 2010 Demonstration, mine pool water augmentation occurred during 53 days (Table 4.1-1). The daily total volume of water pumped from the mine pool for LGS use ranged up to 10.6 MGD and totaled 408.9 MG through the end of the pumping period (Table 4.1-1 and Figure 4.1-1). Most daily volumes pumped were in the range of 6 to 8 MGD and the average volume pumped per day was 7.4 MG. By the end of September pumping had lowered the pool approximately 59 feet, but by January 7, 2011 the mine pool had recharged by 78 feet. This pattern was similar to the findings of previous years. All of the years of the Demonstration including 2010 confirmed the hypothesis that the mine pool could be operated as an underground reservoir. The overall mine pool levels for the Demonstration period and the pumping amounts for augmentation are shown in Table 4.1-1 and Figure 4.1-1.

Specific conductance varied from 1,105 to 1,286 µmhos/cm. Specific conductance was similar during July through early September, then decreased slightly during the prolonged pumping in September (Figure 4.1-2). Mean specific conductance was within the range of values observed during previous years.

Several other water quality parameters were determined on a monthly basis and included those required by the mine’s NPDES permit plus total organic carbon (TOC), TDS, DO, pH, specific conductance and temperature. Water samples were collected from the pump discharge for analysis.

In general, Wadesville Pool water was cold, neutral in pH with low acidity, low TOC, and relatively high TDS (Tables 4.1-2 and 4.1-3). All measurements of the parameters commonly associated with mine water (iron and manganese) were within the expected historical range.[1]

Over the 8 years of the Demonstration, TDS and pH varied within a narrow range from year to year and on average have been fairly stable (Table 4.1-2 and 4.1-3). Average values of manganese have been similar over the past 8 years, while the values of iron have been variable with the lowest values reported during 2009.

An annual erosion survey has been completed prior to the start of each demonstration period. In addition, observations for channel erosion were conducted approximately monthly during the Demonstration. The area surveyed was from the point where the Wadesville Pumphouse discharge flume enters the unnamed tributary to approximately 100 feet beyond the culvert that passes under the New Wadesville road. Some non-sediment debris accumulated at the entrance to the culvert during the off-season and was removed prior to the start of the annual demonstration. Also noted was minor erosion of areas on the sharp slope of the roadway that had deposited sediment at the side of and slightly into the channel, but not enough to impede flow or that required removal.

4.2 Schuylkill River Discharge and Local Rainfall

Schuylkill River discharge (flow) is measured by the U.S. Geological Survey (USGS) at Landingville, Berne, Reading, and Pottstown. These gages are located between the Norwegian Creek confluence and LGS. In addition, rainfall is measured at the Landingville gage. Data for these locations are presented in Table 4.2-1.

Hydrographs for the Schuylkill River at Landingville (gage located nearest to the Norwegian Creek confluence) and at Pottstown (Figure 4.2-1) show that the 2010 Demonstration was characterized by below average river flow during most of the Demonstration period. Mean monthly Schuylkill River flow at Pottstown in 2010 was lower than the period of record for the Pottstown gage for April through September and November (Table 4.2-2). River flows at Pottstown were the lowest during September and were below 1,000 CFS for 105 days during the entire Demonstration period. In addition, the Schuylkill River at Pottstown was below 560 CFS for 43 of the 105 days, which included most of August and September. The lowest mean daily discharge at Pottstown was 346 CFS and was recorded on September 16. Similarly, at the Landingville gage, discharge in 2010 was lower than the period of available flow records at the Landingville gage for April through September and November.

[1] Note that when a discharge from an area disturbed by mining activity without chemical or biological treatment has a pH greater than 6.0 and a total iron concentration of less than 10.0 mg/l, as is the case with Wadesville, the PADEP manganese limitations (2.0 mg/l 30-day average and 4.0 mg/l daily maximum) do not apply [ref. 25 PA Code §88.9(c)(2)].

The USGS notified Exelon on August 6 of an adjustment to estimated flow in the Schuylkill River at the Pottstown gage. The adjustment by the USGS to the Schuylkill River flow at Pottstown resulted in the reduction of instantaneous flow from 950 to 500 CFS, and retroactively reduced Schuylkill River flow for the period of June 15 to August 5. Upon notification of this adjustment Exelon retroactively adjusted the Schuyllkill River restricted flow status to August 1. The cause of the elevated flow measurements was aquatic grasses growing in the vicinity of the gage which caused a backwater in the channel and subsequently higher discharge measurements than what was actually field verified by the USGS. The Schuylkill River flow data reported herein reflect the adjustments to the USGS Pottstown gage.

Overall, Schuylkill River Basin hydrology in 2010 can be characterized as being dry. Rainfall during the 2010 period was characterized by a few large rainfall events during the spring and fall and limited rainfall during the summer months. This rainfall pattern resulted in dry conditions during most of the summer. Rainfall at Landingville during the 2010 Demonstration period was 32.56 inches. This is greater than rainfall during the 2005, 2007, and 2008 Demonstrations (21.80, 26.45, and 27.28 inches, respectively) and is lower than rainfall amounts recorded during the 2004, 2006, and 2009 Demonstrations (40.30, 41.07, and 32.57 inches).

4.3 Lower Schuylkill River Water Quality

Dissolved Oxygen (DO), temperature, and pH were monitored hourly using Hydrolab Minisonde 4A instruments at four locations on the lower Schuylkill River: in front of the LGS cooling water intake, at the Pennsylvania American Water Company Intake, at Black Rock Dam, and in the Norristown Pool (Figure 4.3-1). At the LGS Intake, the instrument was suspended just below the water surface from a floating dock located in front of the intake structure. The monitor in Black Rock Pool was installed within a perforated pipe enclosure affixed to the Dam so that the monitor sampled the water about to flow over the dam. This monitor had previously been located on the Chester County side of the dam but was relocated to the Montgomery County side of the Dam in 2009 as a result of construction of a fish ladder on the Chester County side of the dam. At the Pennsylvania American Water Company Intake, the Hydrolab was installed inside a perforated pipe enclosure that was mounted to the upstream side of the intake structure. In Norristown Pool, the monitor was installed in a similar enclosure mounted to a support structure on the Norristown (Montgomery County) side of the road bridge leading to Barbados Island. Monitoring began on April 15 and ended on November 30.

In addition, DO data are available from a USGS monitoring station in the former location of Vincent Dam, near Linfield, which is located downstream of LGS (Figure 4.3-1). The Vincent Dam was demolished and removed during October 2009 which returned this section of the River to more natural free flowing environment. Prior to the dam being removed, natural breaching had been underway for several years and resulted in the reduction of the size of the pool formed by the dam and the main flow of the river had moved away from the gage site. This resulted in the DO readings being collected from water that was not part of the main flow of the river at low discharge rates. As a result, DO values measured at low flows were typically much lower than those observed at the other four monitoring locations. Data from this site are presented for the period from April 15 to September 30 in Table 4.2-1. USGS's monitoring program is discontinued at this station annually from fall to late spring.

Dissolved Oxygen concentrations generally followed the same trend at each of the five stations throughout the Demonstration period (Figures 4.3-2 through 4.3-8, Table 4.3-1). The lowest monthly mean DO concentrations for the four Exelon stations were recorded in June or July. The lowest instantaneous minimum DO values for the four Exelon stations were recorded in June at Black Rock Pool, August and September at Limerick Intake, and October at Pennsylvania American Intake and Norristown Pool. For the Vincent Dam station the lowest monthly mean DO concentration was recorded in June and the lowest instantaneous minimum DO value was recorded in July. Instantaneous minimum DO values for the four Exelon stations were never below 4.00 mg/l. The lowest instantaneous DO at the Vincent Dam station (1.80 mg/l) was recorded on July 13 and was not representative of the DO values recorded at the Exelon monitoring stations in the vicinity of this location. Note that the Vincent Dam station is subject to questionable DO values, perhaps arising from an instrumentation issue (a relatively common occurrence at this monitor). The USGS removed DO values from their provisional data set for the Vincent Dam station from July 14 to July 22 due to instrumentation issues.

The lowest mean daily DO value (4.86 mg/l) for all Exelon monitoring stations was recorded in Norristown Pool on July 11, following a rainfall event the prior day (Table 4.2-1), and is slightly below the DO trigger value (5.0 mg/l) for the Demonstration. The lowest instantaneous DO concentration (4.44 mg/l) was recorded at Black Rock Pool on June 29 (Table 4.3-1) and was above the minimum instantaneous Pennsylvania water quality standard of 4.0 mg/l.

During the Demonstration period, DO concentrations usually cycled over 24-hour (diel) periods with the highest concentrations found during the late afternoon to early evening hours and lowest concentrations during the early morning hours (Figure 4.3-9). This diel oscillation in DO concentrations is typical of rivers and is primarily due to aquatic vegetation photosynthesis in excess of aquatic organism respiration during daylight and continued respiration with no photosynthesis during the night. Disruptions to the normal diel cycle usually were related to rainfall events and the resulting rise in river flow.

The 2010 monitoring program offered an exceptional opportunity to evaluate the relation of Schuylkill River low flows at the Pottstown USGS gage to DO measured at four locations in the Schuylkill River. For much of August through September, Schuylkill River flow was less than 560 CFS. Several regression analyses were performed to determine the relation of DO to Schuylkill River flow. Mean daily DO was not well correlated to Schuylkill River flow at any of the four Exelon monitoring stations during the 2010 Demonstration (Figure 4.3-10). Similarly, mean daily DO was not well correlated to Schuylkill River flow less than 560 CFS (Figure 4.3-11). A third and final analysis was completed to assess the relation of instantaneous minimum dissolved oxygen concentrations to Schuylkill River flow less than 560 CFS. Similar to the two previous analyses, instantaneous minimum DO was not well correlated to Schuylkill River flow less than 560 CFS (Figure 4.3-12). The lack of a direct relation of DO to river flow is similar to observations during the previous years of the Demonstration.

In general, mean pH over the Demonstration period was similar for all four stations with lowest mean pH (7.16) and lowest instantaneous minimum pH (6.21) recorded at Norristown Pool during October. The highest instantaneous maximum (9.12) pH recorded from Limerick Intake in November (Table 4.3-2). The largest recorded variation in daily pH measurements was 1.61 at Limerick Intake on November 22 (Figure 4.3-4). This diel variation in pH was observed at all stations, as expected, coincident with the cycling of DO (Figures 4.3-4 to 4.3-8). Photosynthesis by aquatic plants removes carbon dioxide from water during daylight, thus causing a rise in pH. Then, during the night, aquatic plant respiration produces carbon dioxide which decreases the pH.

Temperature variations for all of the stations were similar with July being the warmest month for all four stations. Temperature for Limerick Intake, Pennsylvania American, Black Rock Pool, and Norristown Pool are provided in Table 4.3-3 and Figures 4.3-4 to 4.3-8.

4.4 Lower Schuylkill River Water Treatment Facilities

Pottstown Water Treatment Plant

The Borough of Pottstown's Water Treatment Plant is the first drinking water intake on the Schuylkill downstream of Pottsville and, therefore, the first intake potentially affected by water pumped from the Wadesville Mine Pool. Pottstown routinely measures the pH and specific conductance of the raw water withdrawn from the Schuylkill River. The Borough of Pottstown's data was utilized to supplement Exelon's data collection efforts. The pH of the intake water is recorded at 2-hour intervals each day. The observed daily ranges are shown in Table 4.4-1. During the Demonstration, intake water pH ranged from 6.9 to 8.7 standard units. Although the daily range on most dates was 0.5 standard units or less, the greatest range observed was 1.2 standard units and occurred on August 11.

The daily measurements of specific conductance ranged from 280 to 505 µmhos/cm, with most readings in the range of 375-450 µmhos/cm (Table 4.4-1). The relation of specific conductance to river discharge is illustrated in Figure 4.4-1. In general, much variation in specific conductance was evident at river discharges less than 1,000 CFS. Overall, specific conductance and pH values measured during the 2010 Demonstration were within the same range of values observed during the previous six Demonstration years.

Sampling of additional parameters, i.e., TDS, iron, manganese, total organic carbon (TOC), and sulfides, was scheduled to take place at the Pottstown water intake when river flows at the USGS Pottstown gage decreased below 560 CFS for four consecutive days. The purpose of this sampling was to assure that Borough personnel were informed about water quality trends that could result in increased treatment costs or potentially cause a violation of the drinking water quality limits applicable to the finished water. Low flow sampling occurred on 7 days during the 2010 Demonstration (Table 4.4-2). Pottstown Water Treatment Plant did not notify Exelon of any changes to public water supply treatment during the Demonstration in 2010.

Pennsylvania American Water Company

The Pennsylvania American water intake on the Schuylkill River near Linfield (below LGS but upstream of the Vincent Pool USGS monitoring site) was sampled for TDS on 13 occasions from April 27 to November 1. Monthly sampling was to be completed unless river flows at Pottstown were below 560 CFS, then weekly sampling was to be performed. River flows during 2010 were below 560 CFS for most of August and September.

Measures of TDS over the entire Demonstration at the Pennsylvania American intake ranged from 145 to 398 mg/l with all values being below the threshold limit for finished drinking water. The relation of total dissolved solids to river flow is given in Figure 4.4-2.

Specific conductance measured at the Pennsylvania American Intake ranged from 284 to 548 µmhos/cm. The relation of conductivity to river flow is presented in Figure 4.4-3.

In addition, DO, pH, and temperature were also determined at the Pennsylvania American Intake (Table 4.4-3).

4.5 East Norwegian Creek and Upper Schuylkill River Water Quality

Monthly water quality sampling was conducted at single locations in East Norwegian Creek and in the Schuylkill River upstream and downstream of the confluence with East Norwegian Creek (Figure 4.5-1). Water quality measurements taken on a monthly basis included DO, pH, specific conductance, and temperature. Additional sampling was also completed for total dissolved solids and total alkalinity during the months that biological sampling was performed. The East Norwegian Creek station is located near Coal Street in Pottsville, immediately upstream of the long culvert which conveys the stream underground through Pottsville. Schuylkill River Station 106 is located approximately 0.5 miles upstream of the mouth of Norwegian Creek, Station 107 is between Station 106 and the mouth of Norwegian Creek, while Station 109 is located approximately 3 miles downstream of the confluence. The numbering and location of these stations correspond to sites sampled previously by the PA Fish and Boat Commission. For the upstream stations, temperature data was recorded at Station 107 and water quality data was collected at Station 106. At Station 109 (downstream) both water quality and temperature data were collected.

Based on Exelon’s data, mixing Norwegian Creek water with the Schuylkill River seemed to have a small positive effect downstream of the confluence (Table 4.5-1). In general, total dissolved solids, specific conductance, total alkalinity, and pH were higher downstream. These same relationships were observed during the previous years of the Demonstration. Norwegian Creek water adds buffering capacity to the river (higher total alkalinity) and has a higher pH. This addition of water acts to improve the water quality of the Schuylkill River.

Daily water temperature measurements were recorded using Onset StowAway temperature loggers in East Norwegian Creek and at Schuylkill River Station 107 and 109. The monitoring stations are the identical locations that were monitored for ambient river temperature in prior years of the Demonstration. Temperatures for all three stations were recorded from April through November.

As expected, the East Norwegian Creek discharge had a slight cooling effect on the Schuylkill River during the summer, but this effect did not persist very far downstream. Daily mean temperatures in East Norwegian Creek (50-70 °F) were regularly lower in the summer and slightly warmer in the fall than the Schuylkill River at Stations 107 (47-71 °F) and 109 (49-73 °F) (Figure 4.5-2). The water temperature at Station 109, approximately 3 miles downstream of the Norwegian Creek confluence, was generally the warmest.

4.6 Upper Schuylkill River Biological Monitoring

Schuylkill River biological monitoring was completed during May, August, and December. The biological monitoring consisted of sampling fish and benthic macroinvertebrates (aquatic insects and other organisms that live on or in the river bottom) at indicator stations in the Schuylkill River upstream (Station 106) and downstream (Station 109) of the Norwegian Creek confluence (Figure 4.5-1). Stations 106 and 109 are part of the array of Schuylkill River locations previously sampled by the PA Fish and Boat Commission. The December sampling event did not include fish sampling because of high river flows which prevented effective and representative sampling.

Fish were captured by electrofishing, with two tow boats, in approximately equal lengths of river at both stations. Captured fish were identified, counted, measured for total length (maximum of 100 individuals per species), and released alive to the river. Benthic macroinvertebrates were collected during single 15-second kick samples in two fast water velocity riffles and two slower water velocity riffle/runs using a D-frame kicknet (500µm). The kick samples for each station were combined and were preserved with isopropanol for transport to the laboratory where all macroinvertebrates were sorted from sample residue, identified, and counted. Both the fish and benthic macroinvertebrate sampling methods are standard procedures in aquatic biological investigations and were used in the previous Demonstration periods.

Similar fish species composition was present at both stations (Table 4.6-1). A total of 10 species or hybrids was collected at Station 106 while 16 species or hybrids was collected at Station 109. The most common species were blacknose dace, creek chub, and white sucker. Other abundant species included green sunfish and tessellated darter. Similar numbers of fish were captured at both stations during May and August.

Rainbow, brown, or brook trout were captured at both stations on each sampling date, but wild salmonids were only a small proportion of the total fish collected. Greater numbers of salmonids were found at Station 109 than Station 106.

The results for 2010 are similar to what was observed in previous years and indicate little effect of the Norwegian Creek discharge (Tables 4.6-2 and 4.6-3, Figure 4.6-1). There was little difference in fish species composition and in which fish species were most abundant between the stations or among years. Station 109 fish species richness ranged from 11 to 18 taxa and Station 106 fish species richness ranged from 8 to 9 taxa. Furthermore, relatively similar total numbers of fish were captured at both stations during all sample years. Of note was the general pattern of fewer numbers of fish being collected during wet years compared to dry years. This pattern was most evident at Station 109 where average number of fish collected was lower during wet years (2003, 2004, 2006, and 2009) than during dry years (2005, 2007, 2008, and 2010). This pattern may partly be explained by the inherent difficultly of collecting fish at higher stream flows. The combination of deeper water, faster currents, and greater wetted area of stream to sample typically reduces electrofishing collection efficiency.

Benthic macroinvertebrates were collected in May, August, and December. Overall, similar numbers of macroinvertebrate taxa were collected at both stations and greater total numbers of macroinvertebrates were collected downstream than upstream of the Norwegian Creek confluence (Table 4.6-4). During 2010 a total of 32 taxa was collected at Station 106 and 22 taxa at Station 109. The total number of macroinvertebrates collected was higher at Station 109 (n = 3,338) than Station 106 (n = 2,035).

In general, a total of 22 or 32 macroinvertebrate taxa can be considered low compared to other streams within the region not impaired by acid mine drainage which affects the upper Schuylkill River. Of the insect taxa considered intolerant of environmental disturbance, few mayfly (Ephemeroptera) taxa and one stonefly (Plecoptera) taxon were collected at either station. Two mayfly genera were collected both downstream and upstream of the East Norwegian Creek confluence. Six caddisfly (Trichoptera) taxa, also considered disturbance-intolerant, were collected between the two stations, with greater numbers of individuals collected at Station 109. Most of the mayfly, stonefly, and caddisfly taxa collected at both stations are considered to be tolerant forms with the most abundant taxon of this group, *Hydropsyche*, a pollution tolerant caddisfly.

Other macroinvertebrate taxa present at one or both stations included such crustaceans as scuds (Amphipoda), sowbugs (Isopoda), and worms (Oligochaeta), in addition to several other insect groups. Most noteworthy among the insects, other than the intolerant groups discussed above, were the midges (Chironomidae). Midges were among the dominant taxa during two of the three sampling events for both stations. The midges are composed of many species, are widespread in distribution, and their presence in relatively large numbers is not unusual.

Macroinvertebrate richness has also been fairly constant for each station over the past 8 years while abundance has been variable (Table 4.6-5 and 4.6-6, Figure 4.6-2). Over the entire Demonstration annual species richness at Station 106 ranged from 19 to 32 taxa and relative abundance for each taxon was similar, except for the caddisfly *Hydropsyche* in 2007, 2008, and 2010 which was more abundant than in any of the other years. Station 109 species richness ranged from 22 to 27 taxa and relative abundance of taxa was similar among the years excluding large numbers of tubificid worms collected in 2008. For Station 109 during all years the most abundant macroinvertebrate was the chironomid. Similarly, for Station 106 chironomids were the dominant taxon for most years, except 2007 and 2008 when *Hydropysche* and Chironomidae were essentially co-dominant. Dominance by one taxon is indicative of a stressed macroinvertebrate community and this is clearly evident for this segment of the Schuylkill River.

Overall the results of biological monitoring in the Schuylkill River during 2010 are comparable to those observed during previous years of the Demonstration. No changes in the biological communities over the short or long term can be attributed to the Mine Pool discharge.

4.7 Still Creek Reservoir Discharge Rate and Water Quality

Discharges from Still Creek Reservoir were used to augment Schuylkill River water flow on 60 days from May 28 to September 27. Daily discharge reached a maximum of approximately 24.9 MG and totaled 950.6 MG for the 2010 Demonstration period (Table 4.7-1). The reservoir water elevation was lowered approximately 11.3 feet during the augmentation period. From the last day of augmentation on September 29 until the end of the Demonstration on November 30 the reservoir recharged and water elevation had increased by 4.7 feet.

Measurement of DO in Still Creek below the reservoir were made periodically when releases were occurring and ranged from 8.0 to 8.7 mg/l. The range of DO concentrations was similar to the values recorded during the previous Demonstration periods.

4.8 Little Schuylkill River Water Quality and Discharge

Water quality sampling was conducted on a monthly basis at three locations within the upper Little Schuylkill River (LSR) watershed upstream of Tamaqua. The sampling stations were located in the LSR upstream of the Still Creek confluence and below the SR 1020 bridge (LSR1), in Still Creek near the PA Route 309 bridge (about 0.4 mile below Still Creek Reservoir) (SC1), in the LSR near the PA Route 54 bridge downstream of Still Creek and just above the confluence with Pine Creek (LSR2), and in the LSR near Tamaqua (LSR3) (Figure 4.8-1). These locations were selected to determine the influence of Still Creek Reservoir releases on the LSR which has very poor water quality due to acid mine drainage above the Still Creek confluence. Water samples were collected for lab analysis of TDS and total alkalinity; field determinations of DO, specific conductance, temperature, and pH were performed at the time of sampling.

Onset temperature loggers were installed at the same locations where water quality sampling was conducted and an additional logger was placed at a downstream location in the LSR about 1.3 miles north of Tamaqua. Field determinations of DO, specific conductance, temperature, and pH were performed and aquatic habitat observations were recorded at each of the four stations when the monthly temperature recorder downloads were completed. Temperatures were recorded from April 15 to November 29.

For all sampling dates, pH and total alkalinity in the LSR were higher downstream of the Still Creek confluence than above (Table 4.8-1). Likewise, TDS and specific conductance were typically lower downstream of Still Creek. The Still Creek Reservoir discharge has a positive effect on the chemical quality of the water in relation to its suitability for aquatic life. The Still Creek discharge and other tributaries below the Still Creek confluence dilute the acid mine drainage that contributes a majority of the stream flow to the LSR. These relationships are similar to those observed during the previous years of the Demonstration.

Water temperatures at the two LSR stations downstream of Still Creek and in Still Creek were warmer than in the LSR upstream of Still Creek (Figure 4.8-2). For the study period, mean temperatures were 59°F in Still Creek, 54°F in the LSR upstream, 58°F in the LSR downstream, and 58°F in the LSR at Tamaqua. The warmest temperatures for the LSR stations were recorded from the end of July to early September. The warmest temperatures in Still Creek occurred at the end of May prior to the initiation of augmentation from Still Creek reservoir. During most of the study period the upper LSR station was generally 5°F or more cooler than the other three stations and had the smallest variation in temperature. Flow at this location appeared to be dominated by mine drainage. The higher temperatures and wider range of temperatures at the lower sites appears to reflect natural warming that takes place as rivers flow downstream.

Water quality measurements taken during temperature logger downloads followed the same trends as described previously (Table 4.8-1). Aquatic habitat observations indicated minimal changes at the four stations during the Demonstration period (Table 4.8-2).

During the 2010 Demonstration, Onset U20 pressure transducers were placed in the LSR both upstream (D1) (75 ft) and downstream (D3) (200 ft) of Still Creek and in Still Creek just upstream (D2)(150 ft) of the confluence with the LSR (Figure 4.8-3). The recorder was used to measure pressure hourly and record it at each location. Pressure was then converted to water depth (feet) above the pressure recorder. Pressure measurements were recorded throughout the data collection period and manual stream discharge estimates were determined on eight separate days over a range of flows in order to generate a rating curve to convert pressure readings to stream flow. A simple regression model was used to develop an equation that was then used to estimate stream discharge at a given pressure. Note that extreme high or low flows are not accounted for in the estimates because these values are outside of the range of values used to develop the regression equation.

Little Schuylkill River downstream and Still Creek pressure values were recorded from April 8 to November 30. Additionally, stream discharge is recorded by the USGS, near Tamaqua, several miles downstream of the aforementioned stations. During the entire study period Still Creek (D2) estimated mean discharge was 8 CFS, LSR upstream (D1)estimated mean discharge was 6 CFS, and LSR downstream (D3) estimated mean discharge was 13 CFS. During the same time period LSR mean discharge at the USGS gage (D4) was 44 CFS. Releases for LGS augmentation from Still Creek Reservoir contributed a large portion of the total estimated flow of the Little

Schuylkill station just downstream of Still Creek on 60 days during the Demonstration. Estimated discharges at all four stations were lower than the 2009 Demonstration period. Estimated daily discharge for the three Exelon stations and the USGS station daily discharge followed a similar trend throughout the Demonstration period (Figure 4.8-4).

4.9 Little Schuylkill River Biological Monitoring

Fish communities were surveyed at two different locations downstream of the Still Creek confluence with the Little Schuylkill River in April, August, and September. The most upstream site was near the Tamaqua water plant with the downstream boundary being a few hundred meters downstream of the confluence with Still Creek. The second site was farther downstream and started approximately 200 meters upstream of the Pine Creek confluence (Figure 4.9-1). Sampling in previous years determined that no fish were present upstream of the Still Creek confluence in the LSR, thus no additional sampling was performed upstream of Still Creek. An electrofishing tow boat that produced DC current was used to complete the fish surveys. Captured fish were identified, measured for length, enumerated and released. In addition, water temperature, DO, pH, and specific conductance were recorded during sampling (Table 4.9-1).

A total of two species (yellow perch and brook trout) and six individuals was captured at the most upstream station (LSR below Still Creek) (Table 4.9-1). The brook trout were most likely resident individuals in the LSR and the yellow perch likely originated from Still Creek Reservoir. At the downstream station, (LSR above Pine Creek) more species and greater numbers of fish were collected. Brook trout and white sucker were the most abundant species, similar to the community structure observed during previous years of sampling. Similar to the upstream station, some of the species (chain pickerel, yellow perch, and bluegill) captured downstream were most likely washed down from the reservoir. The greater number and density of fish species at the downstream station can be attributed to the higher pH downstream than upstream. During all sampling visits to these stations (2005-2010), the pH was higher downstream. The higher pH downstream resulted from Niefert Creek and other smaller tributaries which contribute higher pH water to the LSR.

4.10 Perkiomen Creek Water Quality

Monthly water quality measurements were made in Perkiomen Creek upstream and downstream of the East Branch Perkiomen Creek (EBPC) confluence from April 23 to November 2 (Figure 4.10-1). The observations generally indicated small differences in the measured parameters between these locations (Table 4.10-1). However, during two sampling events, July 13 and October 5, bacterial concentrations were much higher downstream of the EBPC confluence than at the upstream station. Both of these sampling events were coincident with rainfall events that resulted in increased discharge in the Perkiomen Creek. Overall, *E. coli* and fecal coliforms concentrations at the downstream station were comparable to previous collections except for the high values recorded on July 13 and October 5 (Table 4.10-1). Upstream of the confluence mean and maximum *E. coli* and fecal coliform concentrations were comparable to those measured during the previous collections.

Measurements of DO and temperature during 2010 were similar to those observed previously at both stations.

4.11 East Branch Perkiomen Creek Water Quality

Measurements of selected water quality parameters were made in the outfall from Bradshaw Reservoir as well as at three locations in East Branch Perkiomen Creek from April 20 to November 18 (Figure 4.10-1). Both *E. coli* and fecal coliform numbers were much higher in the East Branch upstream of the Bradshaw Reservoir outfall, compared to downstream, on most of the sample dates (Table 4.11-1). Similarly, the highest mean *E. coli* and fecal coliform counts for the sample period were typically recorded upstream of the outfall. DO levels were generally higher downstream of the Bradshaw Reservoir outfall in 2010. Mean fecal coliform counts were comparable to those recorded in previous years for upstream of the outfall, downstream at the Bucks Road gage, and downstream at Rt. 73 Bridge. Overall, the general patterns of bacteria and DO concentrations observed among these stations in 2010 are similar to those observed during 2003 through 2009 sampling.

4.12 East Branch Perkiomen Creek Discharge

EBPC flows are recorded by the USGS at the Bucks Road gage and are included here from April 15 to November 30 (Figure 4.12-1). The flows in the upper East Branch Perkiomen Creek, as monitored by the USGS gage, closely reflect the discharge rate from Bradshaw Reservoir except during precipitation events. The Bradshaw Reservoir discharge rate varies from 15 to 40 CFS during the 2010 Demonstration period.

Monthly flows in EBPC during 2010 were similar to 2005-2009 flows (Table 4.12-1). The reduction in Bradshaw Reservoir discharge rate from historic levels was most evident when the May through September discharges during 2005-2010 were compared to the historical discharges during this same seasonal period. Prior to 2005 EBPC discharges during the May-September timeframe were typically between 45-60 CFS; whereas, the 2005-2010 discharges ranged between 13-38 CFS.

4.13 East Branch Perkiomen Creek Erosion Study

A set of channel transects in the upper EBPC has been surveyed annually or more often after flood events since prior to operation of the LGS Water Diversion System. This work is performed in the stream channel just upstream of the outfall from Bradshaw Reservoir to approximately 400 feet downstream of the USGS gage at Bucks Road. Channel erosion is measured by determining the channel width and depth (cross-section) at nine locations along the EBPC. The results from the most recent year are then compared to previous surveys to determine the amount of channel migration and erosion. These surveys focus on changes in the stream channel resulting from the Bradshaw Diversion discharge and from flood events. During the course of study the most apparent changes to channel geometry have occurred following the most severe storm events, those that elevated flow at the gage at Bucks Road above 1,000 CFS. It has been during such short-term disturbances that most of the bank recession occurs. The reduction in Diversion discharge has had no negative effect on EBPC channel erosion.

4.14 East Branch Perkiomen Creek Biological Sampling

Historic sampling of benthic macroinvertebrates and fish in EBPC had been performed prior to and during the Wadesville Demonstration. This work is a continuation of a sampling program that has been in place for many years to monitor the aquatic community subsequent to water releases from Bradshaw Reservoir. The results of this monitoring effort are reported separately to PA DEP. Over the last few years sampling for benthic macroinvertebrates has occurred twice annually, in the summer and late fall, at four locations distributed throughout the EBPC. Fish sampling has occurred annually at four locations in the late fall.

Macroinvertebrate sampling stations are positioned throughout the length of the EBPC (Figure 4.14-1). Here the results are reported for the bi-annual sampling from 1999 to 2009 by reducing the data into two commonly used metrics, total taxa and density. Over this 11-year timeframe total numbers of macroinvertebrate taxa has varied at all four stations (Figure 4.14-2). During the Wadesville Demonstration total taxa has varied within or close to the ranges observed prior to the reduction in Diversion discharges. For example, at station E23000 in the summer total taxa ranged from 21-27 prior to the Demonstration and from 26-34 during the Demonstration. Similarly, macroinvertebrate density has been comparable among years at most of the stations (Figure 4.14-3). The only noteworthy difference in macroinvertebrate density occurred during 2008 at E12500 where density was much greater in the fall than had been observed during the other ten years. The 2010 macroinvertebrate sampling was completed; however, the results were not available at the time of publication.

Fish sampling stations are located throughout the length of the EBPC (Figure 4.14-4). The results of the annual sampling effort from 2002 through 2010, a timeframe in which comparable sampling methodologies were used, are reported here. For ease of reporting, the data were reduced into two commonly used metrics, total fish taxa and abundance. Total number of fish taxa has been fairly stable with total taxa similar prior to and during the changes in the Diversion discharge (Figure 4.14-5). For example, at station E22240 total fish taxa collected was 21 prior to the Demonstration and ranged from 15-22 during the Demonstration. Overall fish abundance has also been similar between the pre-Demonstration period and the Demonstration period (Figure 4.14-6).

There were no observed changes in the benthic macroinvertebrate or fish communities that could be linked to the reduced Diversion flows to the EBPC as part of the Wadesville Mine Water Demonstration Project.

5.0 CONCLUSIONS

The eighth Demonstration period was successfully completed in 2010. All of the objectives that the Demonstration was designed to meet have been fullfilled. These include:

- Provide monitoring under all (high and low) flow conditions
- Monitor and show long-term stability of using alternative augmentations sources (Tamaqua and Wadesville)
- Monitor and analyze potential effects on water quality, aquatic life, and flow resulting from the new conditions
- Confirm the hypothesis that a mine can be operated as an underground reservoir
- Provide an inclusive and open process where all stakeholders and groups have access to the data and provide input.

The Demonstration data continues to show that the Demonstration project provides significant benefit to the Delaware basin during all flow conditions. The data and analysis presented in this report indicate continued positive impacts from headwater augmentation (Wadesville and Still Creek), no detrimental effects from continued management of diversion system flows, and no measurable effects from consumptive water use by LGS.

Elimination of the temperature augmentation requirement which allowed withdrawal of the full amount of consumptive makeup water required by LGS had no measurable affect on DO levels in the lower Schuylkill River. DO levels were not correlated to Schuylkill River flow reductions related to water withdrawal by LGS. The DO levels met the Water Quality Criteria, with one exception, that occurred on July 11 at Norristown Dam when mean daily DO measured 4.86 mg/l.

The minimum flow releases to EBPC maintained stream flow in the East Branch and enhanced the flow in the Perkiomen Creek downstream of LGS's Graterford Intake. There were no adverse impacts to water quality as a result of the reduced releases from Bradshaw Reservoir.

Based on the 8 years of the Demonstration, the data supports:

- Long-term approval of augmentation from Wadesville,
- Long-term approval of augmentation from Still Creek,
- Long-term elimination of the 59°F augmentation requirement,
- Reduction of the Schuylkill River low flow trigger point,
- Year round maintenance of a 10 CFS minimum flow limit in the East Branch Perkiomen Creek,
- Reduction of monitoring and reporting requirements, and
- Long-term approval of scheduled recreational releases of water in the East Branch Perkiomen Creek as requested by citizens groups.

All data in this analysis support a new Docket approving the elements of the demonstration.

The data and analysis shows that the Demonstration approved by Docket Revision 12 is beneficial to the Delaware River basin and should be approved on a long-term basis. Eight years of the Demonstration have shown significant benefits from the Demonstration and fully support its long-term continuation. Long-term continuation of the provisions of the Demonstration will provide a number of important direct and indirect benefits to the water resources of the basin. Included in those benefits are:

- Augmenting flows in the lower portion of the Perkiomen Creek.
- Maintaining higher flows in the Schuylkill River and Little Schuylkill River during low flow periods.
- Optimizing regional water use.
- Extend the time augmentation sources can be used during drought/low flow periods.
- Maintaining increased water flow in the Delaware River.
- Provide a funding source for Schuylkill River basin water quality improvement projects.

The Demonstration continued to be very successful with no significant issues noted to date that would preclude moving to long-term adoption of the revised Docket criteria.

Table 4.1-1. Total volume of water pumped, specific conductance, and pool level for Wadesville Mine Pool Water, June-November 2010.

Date	Totalized Flow (MG)	Daily Flow (MG)	Specific Conductance (µmhos/cm)	Mine Pool Level (Feet)
6/30/2010	0.00	0.00	-	-
7/1/2010	6.60	6.60	-	470.0
7/2/2010	15.07	8.47	1249	472.0
7/3/2010	23.54	8.47	-	474.0
7/4/2010	32.01	8.47	-	477.0
7/5/2010	40.50	8.49	-	479.0
7/6/2010	48.52	8.02	1268	482.0
7/7/2010	50.03	1.51	1268	484.0
7/8/2010 A	-	-	-	-
7/9/2010 A	-	-	-	-
7/10/2010 A	-	-	-	-
7/11/2010 A	-	-	-	-
7/12/2010 A	-	-	-	-
7/13/2010 A	-	-	-	-
7/14/2010 A	-	-	-	-
7/15/2010 A	-	-	-	-
7/16/2010 A	-	-	-	-
7/17/2010 A	-	-	-	-
7/18/2010 A	-	-	-	-
7/19/2010 A	-	-	-	-
7/20/2010 A	-	-	-	-
7/21/2010 A	-	-	-	-
7/22/2010 A	-	-	-	-
7/23/2010 A	-	-	-	-
7/24/2010 A	-	-	-	-
7/25/2010 A	-	-	-	-
7/26/2010 A	-	-	-	-
7/27/2010 A	-	-	-	-
7/28/2010 A	-	-	-	-
7/29/2010 A	-	-	-	-
7/30/2010 A	-	-	-	-
7/31/2010 A	-	-	-	-
8/1/2010 A	-	-	-	-
8/2/2010 A	-	-	-	-
8/3/2010 A	-	-	-	-
8/4/2010 A	-	-	-	-
8/5/2010	50.03	0.00	-	-
8/6/2010	55.03	5.01	-	448
8/7/2010	62.11	7.08	-	450
8/8/2010	69.12	7.01	-	452
8/9/2010	78.42	9.29	1268	454
8/10/2010	89.02	10.60	1268	457

A=Release stopped
B=Estimate due to totalizer reading too high.
C=Estimate for weekend
D=Flow Integrator Repaired, Reset

Table 4.1-1. Continued.

Date	Totalized Flow (MG)	Daily Flow (MG)	Specific Conductance (μmhos/cm)	Mine Pool Level (Feet)
8/11/2010	98.33	9.31	1268	459
8/12/2010	106.71	8.38	1268	461
8/13/2010	116.08	9.37	1268	463
8/14/2010	125.46	9.37	-	465
8/15/2010	134.83	9.37	-	467
8/16/2010	136.65	1.82	1286	470
8/17/2010 A	-	-	-	-
8/18/2010 A	-	-	-	-
8/19/2010 A	-	-	-	-
8/20/2010 A	-	-	-	-
8/21/2010 A	-	-	-	-
8/22/2010 A	-	-	-	-
8/23/2010 A	-	-	-	-
8/24/2010 A	-	-	-	-
8/25/2010	136.65	0.00	-	
8/26/2010 B	141.65	5.00	-	456
8/27/2010 B	149.15	7.50	1268	458
8/28/2010 B	156.65	7.50	-	461
8/29/2010 B	164.15	7.50	-	464
8/30/2010 B	171.65	7.50	1268	467
8/31/2010 B	179.15	7.50	-	469
9/1/2010 B	186.65	7.50	1268	471
9/2/2010 B	194.15	7.50	-	473
9/3/2010 B	201.65	7.50	1268	475
9/4/2010 B	209.15	7.50	-	478
9/5/2010 B	216.65	7.50	-	480
9/6/2010 B	224.15	7.50	-	482
9/7/2010 D		7.50	-	485
9/8/2010	256.01	8.25	1146	484
9/9/2010	263.85	7.84	1144	487
9/10/2010 C	271.64	7.79	1138	489
9/11/2010 C	279.43	7.79	-	490
9/12/2010	287.22	7.79	-	492
9/13/2010	295.50	8.29	-	493
9/14/2010	302.85	7.35	1118	495
9/15/2010	310.45	7.60	1121	497
9/16/2010	317.72	7.27	1122	498
9/17/2010	325.07	7.35	1122	500
9/18/2010	332.42	7.35	-	502
9/19/2010	339.78	7.35	-	504
9/20/2010	347.73	7.95	1109	506
9/21/2010	354.30	6.57	1105	509
9/22/2010	361.01	6.71	1105	511
9/23/2010	368.26	7.26	1109	513
9/24/2010	375.15	6.89	1109	515
9/25/2010	382.03	6.88	-	518
9/26/2010	388.92	6.88	-	520

A=Release stopped
B=Estimate due to totalizer reading too high.
C=Estimate for weekend
D=Flow Integrator Repaired, Reset

Table 4.1-1. Continued.

Date	Totalized Flow (MG)	Daily Flow (MG)	Specific Conductance (µmhos/cm)	Mine Pool Level (Feet)
9/27/2010	395.52	6.60	1120	522
9/28/2010	402.58	7.06	1122	524
9/29/2010	408.89	6.32	1119	527
9/30/2010 A	-	-	1131	529
10/1/2010 A	-	-	-	-
10/2/2010 A	-	-	-	-
10/3/2010 A	-	-	-	-
10/4/2010 A	-	-	-	-
10/5/2010 A	-	-	-	-
10/6/2010 A	-	-	-	-
10/7/2010 A	-	-	-	-
10/8/2010 A	-	-	-	-
10/9/2010 A	-	-	-	-
10/10/2010 A	-	-	-	-
10/11/2010 A	-	-	-	-
10/12/2010 A	-	-	-	-
10/13/2010 A	-	-	-	-
10/14/2010 A	-	-	-	-
10/15/2010 A	-	-	-	-
10/16/2010 A	-	-	-	-
10/17/2010 A	-	-	-	-
10/18/2010 A	-	-	-	-
10/19/2010 A	-	-	-	-
10/20/2010 A	-	-	-	-
10/21/2010 A	-	-	-	-
10/22/2010 A	-	-	-	-
10/23/2010 A	-	-	-	-
10/24/2010 A	-	-	-	-
10/25/2010 A	-	-	-	-
10/26/2010 A	-	-	-	-
10/27/2010 A	-	-	-	-
10/28/2010 A	-	-	-	-
10/29/2010 A	-	-	-	-
10/30/2010 A	-	-	-	-
10/31/2010 A	-	-	-	-
11/1/2010 A	-	-	-	-
11/2/2010 A	-	-	-	-
11/3/2010 A	-	-	-	-
11/4/2010 A	-	-	-	-
11/5/2010 A	-	-	-	-
11/6/2010 A	-	-	-	-
11/7/2010 A	-	-	-	-
11/8/2010 A	-	-	-	-
11/9/2010 A	-	-	-	-
11/10/2010 A	-	-	-	-
11/11/2010 A	-	-	-	-
11/12/2010 A	-	-	-	-

A=Release stopped
B=Estimate due to totalizer reading too high.
C=Estimate for weekend
D=Flow Integrator Repaired, Reset

Table 4.1-1. Continued.

Date		Totalized Flow (MG)	Daily Flow (MG)	Specific Conductance (µmhos/cm)	Mine Pool Level (Feet)
11/13/2010	A	-	-	-	-
11/14/2010	A	-	-	-	-
11/15/2010	A	-	-	-	-
11/16/2010	A	-	-	-	-
11/17/2010	A	-	-	-	-
11/18/2010	A	-	-	-	-
11/19/2010	A	-	-	-	-
11/20/2010	A	-	-	-	-
11/21/2010	A	-	-	-	-
11/22/2010	A	-	-	-	-
11/23/2010	A	-	-	-	-
11/24/2010	A	-	-	-	-
11/25/2010	A	-	-	-	-
11/26/2010	A	-	-	-	-
11/27/2010	A	-	-	-	-
11/28/2010	A	-	-	-	-
11/29/2010	A	-	-	-	-
11/30/2010	A	-	-	-	-

A=Release stopped
B=Estimate due to totalizer reading too high.
C=Estimate for weekend
D=Flow Integrator Repaired, Reset

Table 4.1-2. Water quality measurements (NPDES Permit parameters) of Wadesville Mine Pool Water, May-September 2010 and min, max, and mean values for 2003-2010.

Parameter[1]	Sample Date 5/25/2010	8/31/2010	9/30/2010	May-September 2010 Min	Max	Mean	July-November 2009 Min	Max	Mean	April-October 2008 Min	Max	Mean
pH (Standard Units)	6.65	6.61	6.92	6.61	6.92	6.73	6.63	6.85	6.77	6.70	6.90	6.83
Specific Conductance[2] (µmhos/cm)										1,342	1,841	1,553
Iron, Total	0.78	2.6	3.38	0.78	3.38	2.25	0.49	1.57	0.90	2.47	4.41	3.24
Manganese, Total	0.86	2.36	1.96	0.86	2.36	1.73	2.09	2.34	2.24	2.07	2.65	2.33
Sulfate[2]										525	792	635
Acidity	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40			
Alkalinity	321	369	438	321	438	376	293	373	332	301	393	341
Total Suspended Solids	11	7	139	7	139	52	<5	5	<5	3	9	7

Parameter[1]	May-September 2007 Min	Max	Mean	May-November 2006 Min	Max	Mean	May-September 2005 Min	Max	Mean	May-Octobery 2004 Min	Max	Mean
pH (Standard Units)	6.80	7.20	6.98	6.75	6.90	6.85	6.80	7.20	7.01	6.74	7.40	6.99
Specific Conductance (µmhos/cm)	1,190	1,455	1,384	1,329	1,686	1,532	1,379	1,720	1,494	1,438	1,832	1,654
Iron, Total	0.85	3.6	1.97	2.69	6.95	5.37	1.49	3.36	2.27	0.97	4.04	1.98
Manganese, Total	1.14	2.52	1.97	2.28	2.89	2.49	2.08	2.35	2.21	1.84	2.84	2.30
Sulfate	221	518	394	655	784	720	361	643	473	429	788	581
Acidity												
Alkalinity	326	410	366	311	364	331	337	424	377	308	382	338
Total Suspended Solids	4	7	6	4	13	9	1	7	4	1	9	5

Table 4.1-2. Continued.

Parameter[1]	July-October 2003 Min	Max	Mean
pH (Standard Units)	7.03	7.42	7.25
Specific Conductance (µmhos/cm)	1,274	2,109	1,715
Iron, Total	0.94	2.46	1.64
Manganese, Total	1.96	5.10	2.96
Sulfate	404	1,170	753
Acidity			
Alkalinity	202	337	282
Total Suspended Solids	7	9	8

[1] Total concentration in mg/l unless otherwise indicated
[2] Parameter no longer required for NPDES permit

Table 4.1-3. Monthly water quality measurements of Wadesville Mine Pool Water collected from the pump discharge, April-September 2010 and min, max, and mean values for 2003-2010.

Parameter[1]	Sample Date 4/24/10	5/29/10	6/11/10	8/7/10	9/10/10	April-September 2010 Min	Max	Mean	May-October 2009 Min	Max	Mean
Total Organic Carbon	<0.5	0.8	0.5	<0.5	<0.5	<0.5	0.8	0.6	<0.5	0.9	0.7
Total Dissolved Solids	1,255	1,252	1,020	1,388	868	868	1,388	1,157	1,071	1,394	1,261
Dissolved Oxygen	7.3	7.3	7.1	7.2	7.1	7.1	7.3	7.2	7.0	7.8	7.4
Specific Conductance (µmhos/cm)	1,549	1,528	1,555	1,572	1,285	1,285	1,572	1,498	1,227	1,638	1,481
pH (Standard Units)	6.74	6.84	7.04	6.73	6.85	6.73	7.04	6.84	6.69	6.99	6.86
Temperature (°C)	13.9	14.3	14.2	14.1	14.3	13.9	14.3	14.2	13.9	14.0	14.0

Parameter[1]	April-November 2008 Min	Max	Mean	May-September 2007 Min	Max	Mean	May-November 2006 Min	Max	Mean	May-September 2005 Min	Max	Mean
Total Organic Carbon	0.5	0.6	0.6	0.7	1	0.9						
Total Dissolved Solids	998	1,384	1,182	370	1,141	881	1,058	1,374	1,231	1,129	1,418	1,250
Dissolved Oxygen	6.9	9.6	7.6	7.0	8.6	7.9	8.0	8.8	8.5	7.0	11.3	9.1
Specific Conductance (µmhos/cm)	1,425	1,708	1,589	335	1,456	1,022	1,331	1,582	1,461	1,411	1,990	1,591
pH (Standard Units)	6.76	6.98	6.85	6.70	6.93	6.85	6.90	7.21	7.00	6.89	7.12	6.99
Temperature (°C)	13.7	14.0	13.9	13.6	14.0	13.9	13.9	14.0	14.0	13.5	14.8	14.2

Parameter[1]	May-October 2004 Min	Max	Mean	July-October 2003 Min	Max	Mean
Total Organic Carbon						
Total Dissolved Solids	1,047	1,474	1,257	1,138	1,520	1,303
Dissolved Oxygen						
Specific Conductance (µmhos/cm)	1,438	1,832	1,654	1,274	2,109	1,715
pH (Standard Units)	6.74	7.40	6.99	7.03	7.42	7.25
Temperature (°C)						

[1]Total concentration in mg/l unless otherwise indicated.

Table 4.2-1. Daily mean discharge measured at four USGS gages in the Schuylkill River, total daily rainfall measured at Landingville, and dissolved oxygen measured at Vincent Dam, April-November 2010.

Date	Daily Mean Discharge (cubic feet/second)				Rainfall (inches)	Dissolved Oxygen (mg/l) Vincent Dam	
	Landingville	Berne	Reading	Pottstown	Landingville	Max	Min
4/15/2010	266	576	1270	1730	0.00	10.8	8.9
4/16/2010	291	569	1290	1490	1.04	10.4	8.0
4/17/2010	346	846	1680	2100	0.00	9.1	7.2
4/18/2010	261	622	1430	1860	0.00	10.2	7.8
4/19/2010	241	561	1320	1530	0.00	11.5	8.4
4/20/2010	231	526	1270	1540	0.00	11.4	8.6
4/21/2010	219	505	1110	1270	0.00	10.9	8.2
4/22/2010	214	488	1100	1240	0.00	10.6	8.0
4/23/2010	206	465	1070	1210	0.00	10.2	7.7
4/24/2010	208	448	1030	1160	0.00	9.4	7.4
4/25/2010	292	547	1250	1340	1.49	8.1	6.9
4/26/2010	504	1240	2570	3140	0.37	8.0	6.8
4/27/2010	389	1090	2620	3520	0.06	8.1	7.5
4/28/2010	358	975	2060	2620	0.00	8.4	7.8
4/29/2010	343	905	1810	2310	0.00	7.8	6.8
4/30/2010	326	829	1650	2080	0.00	8.7	5.6
5/1/2010	311	766	1530	1940	0.00	8.3	7.6
5/2/2010	297	723	1470	1820	0.22	7.6	7.1
5/3/2010	487	1540	4440	5640	1.28	7.2	6.4
5/4/2010	377	1270	4660	5760	0.08	7.5	6.6
5/5/2010	346	1060	3410	4440	0.00	7.9	7.2
5/6/2010	317	898	2280	2960	0.00	7.4	6.4
5/7/2010	297	789	1930	2490	0.00	7.3	6.6
5/8/2010	292	738	1760	2250	0.02	6.6	5.9
5/9/2010	273	672	1610	2070	0.00	6.8	6.2
5/10/2010	262	615	1520	1920	0.00	7.9	6.8
5/11/2010	254	574	1480	1870	0.29	7.9	7.2
5/12/2010	404	906	1960	2440	0.66	9.0	7.7
5/13/2010	280	698	1730	2410	0.00	9.4	7.3
5/14/2010	256	593	1420	1850	0.00	8.3	7.0
5/15/2010	277	639	1390	1770	0.00	7.7	6.8
5/16/2010	241	555	1280	1690	0.00	8.4	7.3
5/17/2010	233	518	1170	1550	0.02	8.8	7.8
5/18/2010	238	520	1200	1560	0.34	8.5	8.0
5/19/2010	232	538	1260	1720	0.00	9.0	7.3
5/20/2010	217	489	1180	1550	0.00	8.9	8.3
5/21/2010	206	454	1090	1430	0.00	8.7	7.7
5/22/2010	191	427	1010	1320	0.00	8.8	7.1
5/23/2010	191	420	971	1300	0.04	8.4	7.0
5/24/2010	182	419	987	1290	0.20	8.8	7.2

Provisional data subject to change

*** Data temporarily unavailable at Vincent Dam May 28th through June 1st.

--- Data discontinued by USGS October through March

Table 4.2-1. Continued.

Date	Daily Mean Discharge (cubic feet/second) Landingville	Berne	Reading	Pottstown	Rainfall (inches) Landingville	Dissolved Oxygen (mg/l) Vincent Dam Max	Min
5/25/2010	171	394	986	1290	0.00	8.7	7.1
5/26/2010	160	371	911	1230	0.00	8.7	6.7
5/27/2010	153	351	873	1240	0.23	8.7	5.6
5/28/2010	187	433	1090	1730	0.25	***	***
5/29/2010	161	398	1000	1410	0.00	***	***
5/30/2010	152	388	978	1480	0.00	***	***
5/31/2010	144	360	892	1270	0.01	***	***
6/1/2010	139	346	826	1160	0.00	***	***
6/2/2010	138	332	775	1110	0.00	8.1	6.6
6/3/2010	130	305	697	1020	0.00	7.9	6.3
6/4/2010	128	290	670	978	0.03	7.8	6.2
6/5/2010	135	296	740	1020	0.10	7.7	6.0
6/6/2010	131	290	670	981	0.21	7.2	5.8
6/7/2010	120	263	654	845	0.00	8.0	6.3
6/8/2010	115	240	608	795	0.00	8.3	6.6
6/9/2010	226	281	697	809	1.56	7.6	6.7
6/10/2010	252	690	1510	1640	0.00	8.1	6.6
6/11/2010	143	342	1120	1550	0.00	8.0	7.0
6/12/2010	131	288	790	1010	0.00	8.2	6.9
6/13/2010	136	284	765	1080	0.11	7.8	5.3
6/14/2010	139	323	877	1140	0.00	7.4	5.7
6/15/2010	121	264	753	1000	0.00	8.0	6.0
6/16/2010	119	243	679	889	0.04	7.6	6.3
6/17/2010	112	240	692	945	0.00	8.2	6.3
6/18/2010	111	223	624	853	0.00	8.1	6.4
6/19/2010	107	215	564	767	0.00	8.1	4.8
6/20/2010	102	208	541	741	0.00	8.0	5.8
6/21/2010	96	197	525	725	0.00	8.1	5.5
6/22/2010	95	188	524	695	0.01	8.0	5.9
6/23/2010	99	197	246	814	0.00	8.0	6.0
6/24/2010	100	191	536	743	0.15	7.4	5.7
6/25/2010	91	185	533	804	0.00	8.0	5.7
6/26/2010	84	184	500	728	0.00	8.0	5.9
6/27/2010	81	197	520	729	0.00	7.8	5.7
6/28/2010	101	215	210	748	0.26	7.6	5.2
6/29/2010	83	197	479	773	0.00	8.0	5.7
6/30/2010	78	157	401	694	0.00	8.1	6.2
7/1/2010	77	142	337	629	0.00	8.3	6.5
7/2/2010	84	150	362	619	0.00	8.5	6.7
7/3/2010	84	176	367	599	0.00	8.5	6.8

Provisional data subject to change

*** Data temporarily unavailable at Vincent Dam May 28th through June 1st.

--- Data discontinued by USGS October through March

Table 4.2-1.   Continued.

Date	Daily Mean Discharge (cubic feet/second)				Rainfall (inches)	Dissolved Oxygen (mg/l) Vincent Dam	
	Landingville	Berne	Reading	Pottstown	Landingville	Max	Min
7/4/2010	86	176	368	627	0.00	8.5	6.4
7/5/2010	87	176	363	620	0.00	8.5	4.9
7/6/2010	86	174	374	621	0.00	8.1	5.5
7/7/2010	84	169	366	623	0.00	7.9	5.6
7/8/2010	79	154	361	620	0.00	7.9	5.5
7/9/2010	82	130	343	633	0.00	7.8	5.4
7/10/2010	213	455	609	1730	2.56	6.9	4.3
7/11/2010	89	254	752	1480	0.00	4.6	4.0
7/12/2010	127	188	482	971	0.98	4.7	2.4
7/13/2010	210	550	988	1380	0.22	6.2	1.8
7/14/2010	383	1670	3460	3570	1.43	***	***
7/15/2010	191	886	3720	5490	0.00	***	***
7/16/2010	133	517	2040	2940	0.00	***	***
7/17/2010	114	376	1250	1570	0.00	***	***
7/18/2010	101	300	1000	1250	0.00	***	***
7/19/2010	106	283	803	1000	0.55	***	***
7/20/2010	104	285	828	960	0.01	***	***
7/21/2010	93	230	713	914	0.24	***	***
7/22/2010	101	251	736	1050	0.00	***	***
7/23/2010	84	201	647	886	0.10	9.4	6.1
7/24/2010	104	225	556	705	0.04	9.6	6.2
7/25/2010	187	250	560	712	0.52	9.4	5.8
7/26/2010	147	428	761	812	0.00	***	***
7/27/2010	96	245	596	879	0.00	10.7	8.3
7/28/2010	87	208	463	631	0.00	11.3	6.3
7/29/2010	85	193	462	606	0.08	11.6	5.9
7/30/2010	81	185	431	550	0.00	12.1	6.2
7/31/2010	78	170	412	516	0.00	13.6	6.2
8/1/2010	147	212	445	505	0.64	12.5	5.9
8/2/2010	102	293	665	767	0.00	12.8	6.3
8/3/2010	85	197	550	749	0.00	12.3	6.6
8/4/2010	84	181	481	592	0.01	12.9	6.5
8/5/2010	82	175	445	549	0.00	12.3	5.9
8/6/2010	79	164	405	501	0.00	12.9	5.6
8/7/2010	81	163	375	459	0.00	14.1	5.9
8/8/2010	80	186	373	437	0.00	14.5	5.9
8/9/2010	79	184	410	452	0.00	14.6	5.6
8/10/2010	78	178	467	532	0.00	14.0	5.3
8/11/2010	77	176	469	566	0.00	12.4	5.1
8/12/2010	84	197	466	649	0.46	7.7	4.8

Provisional data subject to change

*** Data temporarily unavailable at Vincent Dam May 28th through June 1st.

--- Data discontinued by USGS October through March

Table 4.2-1. Continued.

Date	Daily Mean Discharge (cubic feet/second) Landingville	Berne	Reading	Pottstown	Rainfall (inches) Landingville	Dissolved Oxygen (mg/l) Vincent Dam Max	Min
8/13/2010	90	253	555	756	0.00	10.4	5.6
8/14/2010	80	195	439	647	0.00	12.4	6.8
8/15/2010	114	203	429	542	0.52	9.0	6.6
8/16/2010	107	282	502	636	0.00	12.2	6.5
8/17/2010	78	211	500	701	0.00	12.2	6.8
8/18/2010	71	166	494	669	0.00	11.6	6.6
8/19/2010	70	138	369	537	0.00	12.9	6.9
8/20/2010	68	131	419	482	0.00	13.7	6.4
8/21/2010	66	127	427	533	0.00	13.2	6.5
8/22/2010	110	146	422	585	1.08	10.9	6.3
8/23/2010	99	248	455	622	0.00	10.2	6.5
8/24/2010	80	178	385	591	0.03	10.7	5.7
8/25/2010	72	152	349	474	0.00	12.2	6.7
8/26/2010	68	140	333	425	0.00	14.2	6.9
8/27/2010	73	141	321	398	0.00	14.8	7.0
8/28/2010	72	167	328	370	0.00	15.5	7.0
8/29/2010	70	166	329	399	0.00	15.9	6.9
8/30/2010	70	164	328	383	0.00	16.8	6.6
8/31/2010	68	159	328	373	0.00	17.1	6.4
9/1/2010	68	146	362	384	0.00	***	***
9/2/2010	67	137	360	426	0.00	***	***
9/3/2010	67	134	367	418	0.00	13.0	4.7
9/4/2010	63	134	402	442	0.00	13.8	5.1
9/5/2010	64	127	392	469	0.00	14.2	5.8
9/6/2010	65	115	380	442	0.00	14.5	6.1
9/7/2010	66	116	385	441	0.00	14.8	6.1
9/8/2010	61	116	430	453	0.00	14.5	5.4
9/9/2010	61	110	487	531	0.00	12.5	5.7
9/10/2010	64	110	458	539	0.00	12.6	6.2
9/11/2010	65	115	473	537	0.00	14.0	6.5
9/12/2010	86	138	519	623	0.54	10.2	6.3
9/13/2010	73	159	464	609	0.00	13.2	6.3
9/14/2010	67	124	341	469	0.00	13.3	6.1
9/15/2010	66	117	333	355	0.00	14.0	6.2
9/16/2010	68	118	332	346	0.19	13.3	6.3
9/17/2010	68	132	398	417	0.01	13.5	5.8
9/18/2010	66	121	505	505	0.00	13.3	6.3
9/19/2010	66	120	496	565	0.00	13.1	6.3
9/20/2010	65	117	480	540	0.00	12.8	6.2
9/21/2010	65	111	518	516	0.00	13.4	6.5

Provisional data subject to change

*** Data temporarily unavailable at Vincent Dam May 28th through June 1st.

--- Data discontinued by USGS October through March

Table 4.2-1. Continued.

Date	Daily Mean Discharge (cubic feet/second)				Rainfall (inches)	Dissolved Oxygen (mg/l) Vincent Dam	
	Landingville	Berne	Reading	Pottstown	Landingville	Max	Min
9/22/2010	100	117	622	654	0.43	13.2	6.8
9/23/2010	110	221	704	772	0.00	11.6	6.0
9/24/2010	70	138	617	840	0.00	11.1	6.1
9/25/2010	65	120	410	523	0.00	12.4	6.0
9/26/2010	64	114	406	431	0.00	10.7	5.6
9/27/2010	112	122	390	453	0.73	9.0	6.2
9/28/2010	147	253	367	519	0.49	11.0	6.2
9/29/2010	80	196	402	485	0.00	11.3	6.0
9/30/2010	967	1700	2170	3090	4.14	7.7	6.8
10/1/2010	1260	4760	12400	16900	1.00	---	---
10/2/2010	508	1780	5570	8770	0.00	---	---
10/3/2010	340	1000	2710	3750	0.00	---	---
10/4/2010	304	775	2000	2410	0.52	---	---
10/5/2010	328	889	2370	3370	0.33	---	---
10/6/2010	293	857	2420	3220	0.12	---	---
10/7/2010	250	715	2010	2470	0.00	---	---
10/8/2010	218	583	1640	1880	0.00	---	---
10/9/2010	197	487	1390	1480	0.00	---	---
10/10/2010	178	421	1200	1230	0.00	---	---
10/11/2010	171	384	1090	1060	0.12	---	---
10/12/2010	200	427	1210	1230	0.51	---	---
10/13/2010	166	360	1090	1140	0.00	---	---
10/14/2010	177	335	1010	996	0.41	---	---
10/15/2010	179	424	1180	1330	0.00	---	---
10/16/2010	147	335	1040	1070	0.00	---	---
10/17/2010	140	297	909	878	0.00	---	---
10/18/2010	134	279	902	1190	0.00	---	---
10/19/2010	136	283	1090	1450	0.15	---	---
10/20/2010	125	257	1070	1470	0.00	---	---
10/21/2010	120	242	981	1340	0.00	---	---
10/22/2010	115	229	884	1220	0.01	---	---
10/23/2010	113	217	817	1110	0.00	---	---
10/24/2010	108	212	791	1080	0.00	---	---
10/25/2010	113	210	768	1040	0.48	---	---
10/26/2010	156	308	946	1090	0.01	---	---
10/27/2010	425	842	1420	1410	0.99	---	---
10/28/2010	259	720	1730	2260	0.00	---	---
10/29/2010	208	546	1400	1760	0.00	---	---
10/30/2010	184	458	1260	1550	0.00	---	---
10/31/2010	169	408	1170	1430	0.00	---	---

Provisional data subject to change

*** Data temporarily unavailable at Vincent Dam May 28th through June 1st.

--- Data discontinued by USGS October through March

Table 4.2-1. Continued.

Date	Daily Mean Discharge (cubic feet/second) Landingville	Berne	Reading	Pottstown	Rainfall (inches) Landingville	Dissolved Oxygen (mg/l) Vincent Dam Max	Min
11/1/2010	154	364	961	1320	0.00	---	---
11/2/2010	144	329	752	1010	0.00	---	---
11/3/2010	140	308	710	952	0.00	---	---
11/4/2010	288	529	1100	1660	0.00	---	---
11/5/2010	300	887	2250	3030	0.00	---	---
11/6/2010	231	683	1930	2540	0.00	---	---
11/7/2010	206	584	1580	2100	0.00	---	---
11/8/2010	191	526	1330	1670	0.00	---	---
11/9/2010	174	480	1200	1530	0.00	---	---
11/10/2010	158	467	1070	1350	0.00	---	---
11/11/2010	144	428	984	1250	0.00	---	---
11/12/2010	136	396	887	1160	0.00	---	---
11/13/2010	134	372	848	1060	0.00	---	---
11/14/2010	130	360	808	1050	0.00	---	---
11/15/2010	127	299	773	997	0.00	---	---
11/16/2010	171	308	806	1010	0.96	---	---
11/17/2010	638	1410	2000	1940	0.60	---	---
11/18/2010	390	1100	2130	2860	0.00	---	---
11/19/2010	332	875	1680	2110	0.00	---	---
11/20/2010	297	757	1450	1750	0.00	---	---
11/21/2010	269	652	1340	1600	0.00	---	---
11/22/2010	244	584	1220	1470	0.00	---	---
11/23/2010	230	538	1140	1360	0.00	---	---
11/24/2010	208	495	1080	1290	0.00	---	---
11/25/2010	224	470	1020	1230	0.37	---	---
11/26/2010	250	561	1150	1330	0.01	---	---
11/27/2010	211	493	1080	1320	0.00	---	---
11/28/2010	187	421	984	1190	0.00	---	---
11/29/2010	172	383	880	1100	0.00	---	---
11/30/2010	199	379	814	1000	0.90	---	---

*** = unavailable

--- = data collection discontinued by USGS October through March at Vincent Dam

Provisional data subject to change

*** Data temporarily unavailable at Vincent Dam May 28th through June 1st.

--- Data discontinued by USGS October through March

Table 4.2-2. Mean monthly flow of the Schuylkill River at the USGS Landingville and Pottstown gages during the 2003-2010 Demonstration periods and mean monthly flows for the period of record.

	LANDINGVILLE GAGE								
MONTH	2003	2004	2005	2006	2007	2008	2009	2010	Period of Record
April	-	-	278	238	-	224	255	293	417
May	-	336	165	174	191	247	370	251	336
June	-	259	109	824	127	131	411	121	252
July	285	359	141	369	97	90	204	118	174
August	389	489	87	139	87	81	366	83	145
September	377	560	73	170	74	85	171	104	160
October	419	292	185	231	107	118	277	239	185
November	-	-	-	-	133	112	381	223	265
December	-	-	-	-	-	429	-	-	351

	POTTSTOWN GAGE								
MONTH	2003	2004	2005	2006	2007	2008	2009	2010	Period of Record
April	-	-	2350	1662	-	1589	1542	1884	2887
May	-	1941	1359	1183	1269	1698	2332	2087	2219
June	-	1664	863	4959	1025	929	3009	926	1645
July	2356	3436	1157	3203	707	648	1603	1168	1285
August	1967	4009	591	1155	654	539	3103	545	1073
September	3348	3952	487	2133	432	771	1636	593	1115
October	2764	2460	2619	1884	877	763	2079	2341	1221
November	-	-	-	-	1204	646	2216	1508	1704
December	-	-	-	-	-	3136	-	-	2242

Table 4.3-1. Instantaneous minimum, maximum, and mean dissolved oxygen concentrations for each month of the Demonstration measured at five stations on the Schuylkill River, April-November 2010.

	Dissolved Oxygen (mg/l)[2]				
	Limerick Intake	Pennsylvania American	Black Rock Pool	Norristown Pool	Vincent Dam[1]
April					
Min	8.09	8.13	7.52	7.88	5.60
Max	14.13	14.28	13.03	11.23	11.50
Mean	10.07	10.38	9.75	9.35	8.57
May					
Min	6.32	6.49	5.48	6.01	5.10
Max	10.63	10.66	9.71	10.02	9.40
Mean	8.57	8.59	7.92	8.01	7.63
June					
Min	5.72	5.83	4.44	4.47	4.80
Max	10.85	13.02	9.73	9.46	8.30
Mean	7.83	7.96	6.88	7.19	6.99
July					
Min	5.58	6.07	4.99	4.59	1.80
Max	12.89	14.61	9.71	9.49	13.60
Mean	8.47	9.21	6.96	6.93	7.07
August					
Min	5.30	4.68	4.91	4.59	4.80
Max	14.04	14.08	10.77	9.58	17.10
Mean	8.31	9.08	7.64	7.13	9.19
September					
Min	5.30	4.73	5.57	5.46	4.70
Max	13.96	13.37	11.21	10.30	15.00
Mean	8.51	9.03	8.35	8.06	8.98
October					
Min	7.19	4.18	6.28	4.17	
Max	13.96	15.11	12.45	13.38	
Mean	9.47	8.75	9.15	9.11	
November					
Min	9.59	8.69	8.69	7.22	
Max	14.88	15.99	15.22	15.16	
Mean	11.51	11.19	11.03	11.00	

[1] Collection of DO data by the USGS at Vincent Dam ended on September 30

[2] Recorded hourly during the Demonstration period

Table 4.3-2. Instantaneous minimum, maximum, and mean observations of pH for each month of the Demonstration measured at four stations on the Schuylkill River, April-November 2010.

	pH (Standard Units)[1]			
	Limerick Intake	Pennsylvania American	Black Rock Pool	Norristown Pool
April				
Min	7.45	7.38	7.39	7.30
Max	8.68	8.59	8.61	8.33
Mean	7.85	7.79	7.80	7.73
May				
Min	7.20	7.23	7.12	7.03
Max	8.18	8.29	7.81	7.67
Mean	7.56	7.57	7.41	7.36
June				
Min	7.36	7.27	7.30	7.09
Max	8.52	8.33	8.08	8.27
Mean	7.74	7.69	7.61	7.44
July				
Min	7.29	7.14	7.20	6.94
Max	8.71	8.73	8.47	8.42
Mean	7.95	7.95	7.84	7.54
August				
Min	7.55	7.46	7.34	6.74
Max	8.90	8.92	8.64	8.24
Mean	8.12	8.14	8.11	7.47
September				
Min	7.26	7.13	7.28	7.01
Max	8.94	8.92	8.77	8.28
Mean	8.08	8.09	8.22	7.69
October				
Min	6.98	6.79	7.02	6.21
Max	8.68	8.81	8.60	8.48
Mean	7.57	7.71	7.59	7.16
November				
Min	7.23	7.10	7.05	6.84
Max	9.12	8.79	8.65	8.94
Mean	7.74	7.84	7.68	7.38

[1] Recorded hourly during the Demonstration period

Table 4.3-3. Instantaneous minimum, maximum and mean temperatures for each month of the Demonstration measured at four stations on the Schuylkill River, April-November 2010.

	Temperature (°F)[1]			
	Limerick Intake	Pennsylvania American	Black Rock Pool	Norristown Pool
<u>April</u>				
Min	51.4	51.6	52.1	53.9
Max	63.6	62.0	62.7	63.3
Mean	57.6	57.3	57.6	59.0
<u>May</u>				
Min	53.2	53.4	52.9	54.7
Max	79.0	77.9	82.8	80.4
Mean	64.9	65.2	66.2	67.3
<u>June</u>				
Min	64.8	64.8	69.2	69.3
Max	85.8	84.5	93.4	88.1
Mean	76.5	76.6	81.9	80.5
<u>July</u>				
Min	70.5	71.3	73.0	76.4
Max	89.6	88.2	99.4	90.0
Mean	79.8	79.9	85.6	83.5
<u>August</u>				
Min	69.9	69.8	74.0	74.1
Max	87.3	86.1	95.0	89.0
Mean	77.4	77.5	83.6	80.9
<u>September</u>				
Min	64.9	65.3	66.6	69.4
Max	85.4	83.7	92.5	86.0
Mean	71.6	71.5	74.1	74.3
<u>October</u>				
Min	51.1	51.0	51.9	53.8
Max	68.4	68.1	68.7	70.7
Mean	58.4	58.1	58.2	59.6
<u>November</u>				
Min	39.0	40.6	40.2	41.9
Max	53.1	52.2	52.5	53.8
Mean	47.3	47.1	46.8	48.0

[1] Recorded hourly during the Demonstration period

Table 4.4-1. Measurements of pH and specific conductance made in Schuylkill River intake water at the Borough of Pottstown's Water Treatment Plant, April-November 2010.

Date	pH Range[1] (Standard Units) Max	Min	Specific Conductance (µmhos/cm)
4/15/2010	8.1	7.6	
4/16/2010	8.1	7.6	
4/17/2010	7.8	7.3	
4/18/2010	8.1	7.4	
4/19/2010	8.5	7.4	
4/20/2010	8.4	7.5	
4/21/2010	8.1	7.3	410
4/22/2010	8.1	7.5	
4/23/2010	8.0	7.7	
4/24/2010	7.9	7.6	
4/25/2010	7.6	7.5	
4/26/2010	7.6	7.5	
4/27/2010	7.6	7.6	
4/28/2010	7.7	7.5	422
4/29/2010	7.7	7.6	
4/30/2010	7.7	7.5	
5/1/2010	7.7	7.5	
5/2/2010	7.7	7.5	
5/3/2010	7.5	7.3	391
5/4/2010	7.6	7.2	
5/5/2010	7.7	7.6	398
5/6/2010	7.6	7.3	
5/7/2010	7.6	7.4	
5/8/2010	7.6	7.3	
5/9/2010	7.7	7.6	
5/10/2010	7.8	7.6	
5/11/2010	7.7	7.6	409
5/12/2010	7.7	7.6	
5/13/2010	7.7	7.6	
5/14/2010	7.7	7.6	400
5/15/2010	7.7	7.6	
5/16/2010	7.7	7.6	
5/17/2010	7.8	7.6	
5/18/2010	7.7	7.6	385

[1] pH is taken every 2 hours during the day

Table 4.4-1. Continued.

Date	pH Range[1] (Standard Units) Max	Min	Specific Conductance (µmhos/cm)
5/19/2010	7.8	7.6	
5/20/2010	7.9	7.5	
5/21/2010	7.9	7.6	390
5/22/2010	7.8	7.6	
5/23/2010	7.7	7.6	
5/24/2010	7.8	7.3	
5/25/2010	7.9	7.5	383
5/26/2010	7.7	7.6	
5/27/2010	7.6	7.4	
5/28/2010	7.5	7.4	370
5/29/2010	7.5	7.3	
5/30/2010	7.7	7.3	
5/31/2010	7.5	6.9	
6/1/2010	8.0	7.4	365
6/2/2010	7.9	7.6	
6/3/2010	7.9	7.6	
6/4/2010	7.8	7.6	350
6/5/2010	7.8	7.5	
6/6/2010	7.8	7.5	
6/7/2010	8.1	7.5	370
6/8/2010	8.2	7.5	
6/9/2010	7.9	7.5	
6/10/2010	7.6	7.6	
6/11/2010	7.8	7.4	381
6/12/2010	7.9	7.5	
6/13/2010	7.8	7.6	
6/14/2010	7.8	7.5	403
6/15/2010	7.9	7.5	
6/16/2010	7.7	7.3	
6/17/2010	7.9	7.5	400
6/18/2010	8.0	7.4	
6/19/2010	7.8	7.4	
6/20/2010	7.9	7.4	
6/21/2010	7.9	7.5	

[1] pH is taken every 2 hours during the day

Table 4.4-1. Continued.

Date	pH Range[1] (Standard Units) Max	Min	Specific Conductance (µmhos/cm)
6/22/2010	7.9	7.5	392
6/23/2010	7.9	7.6	
6/24/2010	7.9	7.6	405
6/25/2010	8.2	7.6	
6/26/2010	8.2	7.7	
6/27/2010	8.3	7.7	
6/28/2010	8.2	7.8	462
6/29/2010	8.3	7.4	
6/30/2010	8.3	7.7	
7/1/2010	8.4	7.7	485
7/2/2010	8.5	7.8	
7/3/2010	8.5	7.8	
7/4/2010	8.5	7.6	
7/5/2010	8.6	7.8	
7/6/2010	8.6	7.7	450
7/7/2010	8.5	7.7	
7/8/2010	8.4	7.6	
7/9/2010	8.5	7.6	440
7/10/2010	7.6	7.4	
7/11/2010	7.6	7.3	
7/12/2010	7.9	7.5	
7/13/2010	7.8	7.5	337
7/14/2010	7.6	7.4	
7/15/2010	7.5	7.3	280
7/16/2010	7.7	7.3	
7/17/2010	7.8	7.6	
7/18/2010	7.9	7.3	
7/19/2010	8.0	7.3	
7/20/2010	8.0	7.6	
7/21/2010	8.2	7.5	300
7/22/2010	8.1	7.6	
7/23/2010	8.2	7.5	330
7/24/2010	8.2	7.7	
7/25/2010	8.1	7.7	

[1] pH is taken every 2 hours during the day

Table 4.4-1. Continued.

Date	pH Range[1] (Standard Units) Max	Min	Specific Conductance (µmhos/cm)
7/26/2010	8.5	7.6	350
7/27/2010	8.5	7.6	
7/28/2010	8.6	7.7	
7/29/2010	8.4	7.8	341
7/30/2010	8.6	7.9	
7/31/2010	8.6	7.9	
8/1/2010	8.4	8.0	
8/2/2010	8.1	7.5	
8/3/2010	7.9	7.6	
8/4/2010	8.2	7.3	
8/5/2010	8.2	7.9	
8/6/2010	8.5	7.7	
8/7/2010	8.5	7.8	
8/8/2010	8.5	7.8	
8/9/2010	8.7	7.8	
8/10/2010	8.4	7.8	361
8/11/2010	8.6	7.4	
8/12/2010	7.9	7.8	
8/13/2010	8.0	7.6	380
8/14/2010	8.3	7.8	
8/15/2010	7.9	7.8	
8/16/2010	8.2	7.3	
8/17/2010	8.2	7.7	404
8/18/2010	8.2	7.6	
8/19/2010	8.4	7.6	400
8/20/2010	8.5	7.7	
8/21/2010	8.5	7.6	
8/22/2010	8.3	7.9	
8/23/2010	8.2	7.7	
8/24/2010	8.0	7.8	377
8/25/2010	8.2	7.7	
8/26/2010	8.6	7.8	
8/27/2010	8.6	7.6	365
8/28/2010	8.7	7.6	

[1] pH is taken every 2 hours during the day

Table 4.4-1. Continued.

Date	pH Range[1] (Standard Units) Max	Min	Specific Conductance (µmhos/cm)
8/29/2010	8.7	7.8	
8/30/2010	8.6	7.9	370
8/31/2010	8.6	7.7	
9/1/2010	8.6	7.8	
9/2/2010	8.6	7.8	392
9/3/2010	8.4	7.8	
9/4/2010	8.6	7.8	
9/5/2010	8.6	7.8	
9/6/2010	8.6	7.8	
9/7/2010	8.7	7.6	410
9/8/2010	8.6	7.8	
9/9/2010	8.3	7.9	
9/10/2010	8.3	7.6	401
9/11/2010	8.5	7.8	
9/12/2010	8.0	7.8	
9/13/2010	8.3	7.5	
9/14/2010	8.5	7.9	463
9/15/2010	8.5	7.6	
9/16/2010	8.2	7.7	482
9/17/2010	8.2	7.7	
9/18/2010	8.2	7.8	
9/19/2010	8.2	7.8	
9/20/2010	8.4	7.9	471
9/21/2010	8.4	7.7	
9/22/2010	8.4	7.3	
9/23/2010	8.1	7.5	
9/24/2010	8.1	7.2	475
9/25/2010	8.1	7.7	
9/26/2010	7.9	7.7	
9/27/2010	7.8	7.6	
9/28/2010	7.8	7.3	450
9/29/2010	8.0	7.5	
9/30/2010	7.5	7.1	465
10/1/2010	7.2	6.9	

[1] pH is taken every 2 hours during the day

Table 4.4-1. Continued.

Date	pH Range[1] (Standard Units) Max	Min	Specific Conductance (µmhos/cm)
10/2/2010	7.2	7.1	
10/3/2010	7.4	7.2	
10/4/2010	7.4	7.1	500
10/5/2010	7.7	7.1	
10/6/2010	7.5	7.3	
10/7/2010	7.6	7.5	
10/8/2010	7.6	7.3	505
10/9/2010	7.7	7.5	
10/10/2010	7.7	7.5	
10/11/2010	7.7	7.4	
10/12/2010	7.7	7.4	
10/13/2010	7.7	7.6	
10/14/2010	7.7	7.5	472
10/15/2010	7.7	7.4	
10/16/2010	7.8	7.6	
10/17/2010	7.8	7.5	
10/18/2010	7.9	7.6	434
10/19/2010	7.9	7.6	
10/20/2010	7.9	7.5	
10/21/2010	8.0	7.4	400
10/22/2010	8.1	7.6	
10/23/2010	8.2	7.6	
10/24/2010	8.2	7.7	
10/25/2010	8.4	7.7	403
10/26/2010	8.0	7.6	
10/27/2010	7.8	7.5	
10/28/2010	7.7	7.5	
10/29/2010	7.8	7.5	410
10/30/2010	7.9	7.6	
10/31/2010	8.0	7.7	
11/1/2010	8.0	7.6	417
11/2/2010	8.0	7.6	
11/3/2010	8.2	7.6	
11/4/2010	7.7	7.6	401

[1] pH is taken every 2 hours during the day

Table 4.4-1. Continued.

Date	pH Range[1] (Standard Units) Max	Min	Specific Conductance (µmhos/cm)
11/5/2010	7.7	7.2	
11/6/2010	7.7	7.4	
11/7/2010	7.9	7.6	
11/8/2010	7.9	7.6	415
11/9/2010	7.8	7.6	
11/10/2010	7.9	7.6	
11/11/2010	8.1	7.7	
11/12/2010	8.2	7.7	400
11/13/2010	8.3	7.7	
11/14/2010	8.4	7.8	
11/15/2010	8.3	7.7	
11/16/2010	7.8	7.5	381
11/17/2010	7.7	7.5	
11/18/2010	7.7	7.4	
11/19/2010	7.8	7.5	350
11/20/2010	7.7	7.7	
11/21/2010	7.9	7.6	
11/22/2010	8.1	7.5	
11/23/2010	7.9	7.5	337
11/24/2010	8.2	7.5	
11/25/2010	7.8	7.4	
11/26/2010	7.9	7.6	
11/27/2010	8.3	7.7	
11/28/2010	8.3	7.6	
11/29/2010	8.2	7.6	
11/30/2010	7.8	7.7	342

[1] pH is taken every 2 hours during the day

Table 4.4-2. Chemical analysis of Schuylkill River water sampled during low flow at the Pottstown Water Treatment Plant, August-September 2010.

Parameter[1]	SAMPLE DATE						
	8/10/2010	8/30/2010	9/1/2010	9/9/2010	9/10/2010	9/22/2010	9/29/2010
River Flow (cfs)[2]	532	399	384	531	539	644	485
Iron, Total	0.05	0.05	0.04	0.04	0.03	0.07	0.2
Manganese, Total	0.018	0.012	0.013	0.021	0.018	0.026	0.05
Copper, Total	0.028	0.021	0.026	<0.01	<0.01	0.037	<0.01
Total Organic Carbon	28.1	2.3	2.3	2.5	2.3	2.3	3.3
TDS	291	339	363	288	282	284	284

[1] Total concentration in mg/l unless otherwise indicated
[2] Approximate flow at time of sampling

Table 4.4-3. Water quality analyses of selected parameters from samples collected at the Pennsylania American Water Treatment Plant intake in the Schuylkill River, April-November 2010.

	SAMPLE DATE									
Parameter[1]	4/27/2010	5/10/2010	6/21/2010	7/19/2010	8/2/2010	8/9/2010	8/23/2010	8/30/2010	9/7/2010	9/20/2010
River Flow, Pottstown (cfs)	3,520	1,880	725	1,300	767	452	548	376	441	540
Total Dissolved Solids	145	163	280	215	256	309	263	398	283	284
Dissolved Oxygen	8.7	10.0	9.0	8.1	10.1	10.5	11.2	13.1	12.2	11.6
Specific Conductance (µmhos/cm)	284	331	423	386	435	445	477	548	481	471
pH (Standard Units)	7.48	7.62	7.81	7.94	8.50	8.67	8.46	8.74	8.71	8.30
Temperature (°C)	13.3	15.0	27.3	27.5	25.6	28.1	24.6	25.3	23.7	21.8

	SAMPLE DATE		
Parameter[1]	9/29/2010	10/11/2010	11/1/2010
River Flow, Pottstown (cfs)	485	1060	1320
Total Dissolved Solids	261	216	202
Dissolved Oxygen	6.3	9.3	11.5
Specific Conductance (µmhos/cm)	450	350	348
pH (Standard Units)	7.53	7.41	7.64
Temperature (°C)	19.9	16.1	11.3

[1] Total concentration in mg/l unless otherwise indicated

Table 4.5-1. Water quality measurements made in East Norwegian Creek and in the Schuylkill River, April-December 2010.

	SAMPLE DATES									April-December 2010			April-October 2009		
Stations/Parameters[1]	4/30/2010	5/26/2010	6/23/2010	7/29/2010	8/10/2010	9/24/2010	10/28/2010	11/30/2010	12/22/2010	Min	Max	Mean	Min	Max	Mean
Schuylkill River at Station 106[2] (upstream)															
Total Dissolved Solids	N/A*	221	N/A*	N/A*	334	N/A*	N/A*	N/A*	204	204	334	253	181	278	230
Total Alkalinity	N/A*	12	N/A*	N/A*	22	N/A*	N/A*	N/A*	14	12	22	16	14	16	15
Dissolved Oxygen	10.5	9.5	9.0	8.5	9.8	9.5	9.7	11.2	11.3	8.49	11.3	10	8.7	12.0	10.0
Specific Conductance (µmhos/cm)	309	339	390	428	412	426	312	317	333	309	428	363	223	412	327
pH (Standard Units)	6.60	6.10	6.58	6.56	6.20	6.42	6.23	6.35	6.44	6.1	6.6	6	5.57	6.96	6.27
Temperature (°C)	11.8	17.7	18.6	21.3	20.7	17.3	12.8	6.8	4.8	4.8	21.3	15	54.1	59.9	58.1
East Norwegian Creek[3]															
Total Dissolved Solids	N/A*	256	N/A*	N/A*	1,226	N/A*	N/A*	N/A*	219	219	1226	567	239	1,131	685
Total Alkalinity	N/A*	45	N/A*	N/A*	316	N/A*	N/A*	N/A*	42	42	316	134	60	280	170
Dissolved Oxygen	9.2	9.1	9.0	8.3	8.1	8.7	9.5	10.8	11.7	8.1	11.7	9	7.2	12.7	9.1
Specific Conductance (µmhos/cm)	1,235	409	1,195	498	1,500	1,256	433	361	377	361	1500	807	409	1,403	969
pH (Standard Units)	8.03	6.80	8.01	7.45	6.60	7.98	7.28	7.24	7.11	6.6	8.03	7	6.45	7.94	7.12
Temperature (°C)	15.7	17.5	16.3	20.2	16.3	15.6	13.3	7.9	5.5	5.5	20.2	14	54.9	62.8	59.5
Schuylkill River at Station 109[4] (downstream)															
Total Dissolved Solids	N/A*	216	N/A*	N/A*	579	N/A*	N/A*	N/A*	204	204	579	333	207	392	300
Total Alkalinity	N/A*	24	N/A*	N/A*	98	N/A*	N/A*	N/A*	18	18	98	47	22	56	39
Dissolved Oxygen	10.6	9.7	9.5	8.1	9.4	10.8	9.7	11.4	11.5	8.11	11.45	10	8.8	12.3	10.3
Specific Conductance (µmhos/cm)	394	350	561	481	680	717	315	325	330	315	717	461	310	582	437
pH (Standard Units)	7.38	6.70	7.88	7.21	8.34	8.09	7.11	7.17	6.58	6.58	8.34	7	6.06	7.65	6.83
Temperature (°C)	13.4	16.4	20.9	22.0	20.1	19.4	14.7	7.2	5.0	5	22	15	55.8	61.2	59.6

* Taken only during months of biological sampling

[1] Concentration in mg/l unless otherwise indicated

[2] Station 106 is located in the Schuylkill River approximately 0.5 mile upstream of the Norwegian Creek confluence.

[3] Sample station is located in East Norwegian Creek immediately upstream of the long culvert which conveys the stream under Pottsville.

[4] Station 109 is located in the Schuylkill River approximately 3.0 miles downstream of the Norwegian Creek confluence.

Table 4.5-1. Continued.

Stations/Parameters[1]	April-November 2008			May-October 2007			May-October 2006			May-November 2005			May-October 2004			July-October 2003		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Schuylkill River at Station 106[2] (upstream)																		
Total Dissolved Solids	116	361	232	209	261	239	155	285	220	196	312	247	169	229	202	222	310	268
Total Alkalinity	14	68	34	12	18	15	18	20	19	12	20	17	19	37	26	5	20	15
Dissolved Oxygen	8.1	12.7	10.3	8.6	11.2	9.9	8.5	11.1	9.7	7.8	12.1	10.1	9.5	10.7	10.0	8.7	10.3	9.3
Specific Conductance (µmhos/cm)	294	530	388	214	350	291	224	461	367	359	516	429	226	491	315	298	353	320
pH (Standard Units)	5.78	7.22	6.60	6.99	7.52	7.16	6.22	7.16	6.92	6.67	7.17	6.83	5.70	6.95	6.50	6.22	7.30	6.75
Temperature (°C)	41.4	67.4	54.4	46.4	71.6	62.7	48.2	65.8	59.0	45.3	66.6	59.5	52.3	61.7	58.3	52.9	62.6	59.2
East Norwegian Creek[3]																		
Total Dissolved Solids	388	967	759	311	877	594	955	1,235	1,095	243	1,294	801	105	1,287	725	252	1,496	941
Total Alkalinity	70	354	257	72	276	174	282	326	304	57	396	241	62	306	232	78	306	173
Dissolved Oxygen	8.8	10.9	9.9	7.6	10.5	9.3	8.8	11.2	9.7	8.0	12.0	10.1	9.6	10.5	10.0	8.5	10.0	9.1
Specific Conductance (µmhos/cm)	399	1,529	973	428	1,224	916	493	1,815	1,169	493	1,701	1,189	369	1,500	1,206	494	1,660	1,186
pH (Standard Units)	6.53	7.60	7.08	6.85	8.05	7.55	6.81	8.28	7.75	6.80	7.89	7.42	6.83	7.95	7.47	7.40	7.97	7.75
Temperature (°C)	48.7	65.5	56.2	60.6	70.0	62.8	48.7	62.2	57.6	47.7	66.9	59.7	52.2	61.7	58.6	55.4	63.5	60.6
Schuylkill River at Station 109[4] (downstream)																		
Total Dissolved Solids	265	532	381	207	270	247	288	497	393	213	476	373	205	339	258	282	402	329
Total Alkalinity	22	130	72	27	48	34	59	96	78	28	125	77	24	68	41	38	53	44
Dissolved Oxygen	8.2	13.0	10.3	8.2	11.0	9.9	8.5	11.6	9.4	9.2	12.2	10.5	9.1	10.9	10.2	8.6	10.3	9.2
Specific Conductance (µmhos/cm)	307	844	523	241	636	403	381	631	492	392	910	651	254	497	372	383	498	439
pH (Standard Units)	6.08	7.91	6.87	6.90	8.16	7.49	7.11	7.94	7.46	6.60	7.92	7.22	5.98	7.39	6.77	7.05	7.40	7.16
Temperature (°C)	44.2	69.7	56.7	48.2	73.8	65.9	48.4	68.2	61.0	46.4	71.6	63.5	51.3	63.5	59.5	52.3	63.0	59.2

* Taken only during months of biological sampling

[1] Concentration in mg/l unless otherwise indicated

[2] Station 106 is located in the Schuylkill River approximately 0.5 mile upstream of the Norwegian Creek confluence.

[3] Sample station is located in East Norwegian Creek immediately upstream of the long culvert which conveys the stream under Pottsville.

[4] Station 109 is located in the Schuylkill River approximately 3.0 miles downstream of the Norwegian Creek confluence.

Table 4.6-1. Fish collected by electrofishing at Stations 106[1] and 109[2] in the Schuylkill River, May and August 2010.

	Sample Date:	26 May				11 August			
	Sample Station:	106 Upstream		109 Downstream		106 Upstream		109 Downstream	
Scientific Name	Common Name	Total No.	Length Range (mm)	Total No.	Length Range (mm)	Total No.	Length Range (mm)	Total No.	Length Range (mm)
Salvelinus fontinalis	brook trout (wild)	4	50 - 240	2	176-214	2	152-252	1	214
Onchorynchus mykiss	rainbow trout (hatchery)			1	335			5	128-345
Salmo trutta	brown trout (hatchery)	16	187 - 276	33		1	252	19	200-362
Salmo trutta	brown trout (wild)			11	59 - 88			7	100-214
Rhinichthys atratulus	blacknose dace	423	42 - 77	596	52 - 80	245	50-78	377	36-84
Semotilus atromaculatus	creek chub	121	50 - 202	43	62 - 138	156	28-173	36	78-128
Semotilus corporalis	fallfish							3	206-240
Catostomus commersoni	white sucker	110	62 - 390	334	58 - 410	117	35-345	482	38-325
Ameiurus nebulosus	brown bullhead							3	133-192
Lepomis cyanellus	green sunfish	20	38 - 142	13	38 - 124	30	42-110	28	48-138
Lepomis macrochirus	bluegill	1	52	1	44			14	68-195
Lepomis spp.	sunfish hybrid	1	110	1	123			2	90-93
Micropterus salmoides	largemouth bass					3	48-57	6	38-68
Micropterus dolomieu	smallmouth bass							2	64-69
Esox niger	chain pickerel							1	130
Etheostoma olmstedi	tessellated darter	7	52 - 68	11	37 - 70	6	45 - 60	27	48-82
Perca flavescens	yellow perch			1	155			1	134
Total Species:		9		11		8		16	
Total Individuals:		703		1047		560		1014	

Physicochemical data:

	106 (26 May)	109 (26 May)	106 (11 August)	109 (11 August)
Time:	13:18	9:52	12:30	8:55
Water Temp (°C):	17.7	16.4	20.7	20.1
DO (mg/l):	9.5	9.65	9.8	9.4
pH:	6.10	6.7	6.20	8.64
Specific Conductance (µmhos/cm):	339	350	412	680

[1] Station 106 is located in the Schuylkill River approximately 0.5 mile upstream of the Norwegian Creek confluence.
[2] Station 109 is located in the Schuylkill River approximately 3 miles downstream of the Norwegian Creek confluence.

Table 4.6-2. Total number of fish collected by electrofishing at Station 106 in the Schuylkill River, 2003-2010.

		Total Number Collected							
Scientific Name	Common Name	2010[b]	2009[b]	2008[a]	2007[a]	2006[b]	2005[c]	2004[d]	2003[d]
Salvelinus fontinalis	brook trout (wild)	6	1	4	16	21	68	45	1
Salvelinus fontinalis	brook trout (hatchery)				1				
Onchorynchus mykiss	rainbow trout (hatchery)						2		
Salmo trutta	brown trout (hatchery)	17	1	1		1		1	
Rhinichthys atratulus	blacknose dace	668	855	967	768	606	1,166	549	444
Cyprinus carpio	common carp								1
Semotilus atromaculatus	creek chub	277	178	572	253	229	330	336	368
Notemigonus crysoleucas	golden shiner		1	1		2		4	
Carassius auratus	goldfish				1				
Catostomus commersoni	white sucker	227	214	732	620	550	961	307	284
Ameiurus natalis	yellow bullhead								1
Ameiurus nebulosus	brown bullhead			2	3		1	1	
Lepomis auritus	redbreast sunfish				1				
Lepomis cyanellus	green sunfish	50	61	130	164	82	297	614	148
Lepomis gibbosus	pumpkinseed		2		4	7	62	16	11
Lepomis macrochirus	bluegill	1	4	1	1	2	2	16	3
Lepomis spp.	sunfish hybrid	1			3		1	4	
Micropterus salmoides	largemouth bass	3			1				
Etheostoma olmstedi	tessellated darter	13	2	3		2		1	
Total Number		1,263	1,319	2,413	1,836	1,502	2,890	1,894	1,261
Species Richness		10	10	10	12	10	10	12	9

[a] three sampling events

[b] two sampling events

[c] six sampling events

[d] four sampling events

Table 4.6-3. Total number of fish collected by electrofishing at Station 109 in the Schuylkill River, 2003-2010.

Scientific Name	Common Name	Total Number Collected							
		2010[b]	2009[b]	2008[a]	2007[a]	2006[b]	2005[c]	2004[d]	2003[d]
Salvelinus fontinalis	brook trout (wild)	3	8	5	3		86	19	5
Salvelinus fontinalis	brook trout (hatchery)				1				
Onchorynchus mykiss	rainbow trout (hatchery)	6	14	213	221	142	7	7	3
Onchorynchus mykiss	rainbow trout (wild)								
Salmo trutta	brown trout (hatchery)	52	5	16	90	94	1,165	16	16
Salmo trutta	brown trout (wild)	18	1						
Rhinichthys atratulus	blacknose dace	973	732	1,072	687	289	436	147	177
Rhinichthys cataractae	longnose dace		4						
Semotilus atromaculatus	creek chub	79	35	25	28	12	35	38	23
Semotilus corporalis	fallfish	3	4	9	3				
Catostomus commersoni	white sucker	816	541	1,877	1,824	715	2,493	460	157
Ictalurus punctatus	channel catfish								1
Ameiurus natalis	yellow bullhead					1		3	1
Ameiurus nebulosus	brown bullhead	3		15	8	2	1	3	
Lepomis auritus	redbreast sunfish							1	
Carassius auratus	goldfish						3		1
Notemigonus crysoleucas	golden shiner					2			
Lepomis cyanellus	green sunfish	41	9	36	26	39	260	350	33
Lepomis gibbosus	pumpkinseed			4	6	4	2	15	6
Lepomis macrochirus	bluegill	15	17	5	4	3	2	3	17
Lepomis spp.	sunfish hybrid	3	1	4	1	3		1	
Micropterus salmoides	largemouth bass	6	3		1	2	4	3	
Micropterus dolomieus	smallmouth bass	2							
Notropis hudsonius	spotail shiner					1			
Esox niger	chain pickerel	1		1					
Etheostoma olmstedi	tessellated darter	38	28	69	23	5	10	1	
Perca flavescens	yellow perch	2	1	4	3				
Total Number		2,061	1,403	3,355	2,929	1,314	4,504	1,067	440
Species Richness		16	15	15	15	15	13	15	12

[a] three sampling events

[b] two sampling events

[c] six sampling events

[d] four sampling events

Table 4.6-4. Benthic macroinvertebrates collected at Stations 106[1] and 109[2] in the Schuylkill River, May, August, and December 2010.

Taxon	Sample Date: / Sample Station:	26 May 106 Upstream	26 May 109 Downstream	10 August 106 Upstream	10 August 109 Downstream	22 December 106 Upstream	22 December 109 Downstream
Nematoda (round worms)		12	28	3	24	5	21
Nemertea (ribbon worms)							
Prostoma		1		1	24	4	
Veneroida (clams)							
Pisidium					22		
Oligochaeta (worms)				36	168		
Enchytraeidae		26	8			5	
Megadrili		3	112				3
Naididae			60				
Tubificidae		1				3	2
Hydrachnidia (water mites)							
Acari				1	1	3	1
Isopoda (sowbugs)							
Caecidotea			68		360		11
Amphipoda (sideswimmers)							
Crangonyx			55		400		16
Stygonectes		30		1			
Decapoda							
Cambarus				2			
Orconectes			1				
Ephemeroptera (mayflies)							
Acentrella			1		2		
Baetis			8	20	126		
Plauditus				2			
Plecoptera (stoneflies							
Leuctra						1	
Megaloptera							
Nigronia						1	
Trichoptera (caddisflies)							
Cheumatopsyche				8		40	
Diplectrona		1		8			
Glossosoma			3				4
Hydropsyche		33	52	560	640	160	180
Lype						2	
Rhyacophila						1	
Coleoptera (beetles)							
Helichus					1		
Optioservus				16	3		
Diptera (true flies)							
Antocha						2	9
Bezzia		1					
Chelifera				4			
Chironomidae		680	564	264	344	51	11
Clinocera		5					

Table 4.6-4. Continued.

Taxon	Sample Date: Sample Station:	26 May 106 Upstream	109 Downstream	10 August 106 Upstream	109 Downstream	22 December 106 Upstream	109 Downstream
Diptera (true flies) - continued							
Chrysops						1	
Dicranota				4			
Hemerodromia			2	18	1	5	
Ormosia						1	
Palpomyia gr.		2					
Pericoma						1	
Probezzia						2	
Psychoda						1	
Simulium					1		
Tipula		1		2			1
Total Taxa		13	13	17	15	19	11
Total Individuals		796	962	950	2117	289	259

[1] Station 106 is located in the Schuylkill River approximately 0.5 mile upstream of the Norwegian Creek confluence.

[2] Station 109 is located in the Schuylkill River approximately 3 miles downstream of the Norwegian Creek confluence.

Table 4.6-5. Total number of macroinvertebrates collected at Station 106 in the Schuylkill River, 2003-2010.

Taxon	Total Number							
	2010[a]	2009[b]	2008[a]	2007[a]	2006[b]	2005[c]	2004[d]	2003[d]
Nematoda (round worms)	20	9	25	3				
Nemertea (ribbon worms)								
Prostoma	6	13	23	3	3			1
Veneroida (clams)								
Pisidium		1			13			
Gastropoda (snails)								
Physa					1			
Oligochaeta (worms)	36		13					
Enchytraeidae	31	12	5			3	2	3
Lumbricina		2					11	3
Lumbriculidae					13	1	3	
Megadrili	3							
Naididae		3	2	1	6			
Tubificidae	4	8		8	1	3	1	3
Hydrachnidia (water mite)		5	7	1				
Acari	4							
Isopoda (sowbugs)								
Caecidotea					129	1		2
Amphipoda (scuds)								
Crangonyx		3	7		1			
Stygonectes	31			5		29	12	10
Decapoda (crayfish)								
Cambarus	2		2			2		1
Orconectes						1		
Ephemeroptera (mayflies)								
Acentrella		1	2					
Baetis	20		29	13	2			
Plauditus	2							
Megaloptera (fishflies)								
Nigronia	1	3	8	15	2	49	3	2
Sialis						10	4	4
Plecoptera (stoneflies)								
Allocapnia								2
Amphinemura							1	
Leuctra	1			2		32	5	1
Trichoptera (caddisflies)								
Ceratopsyche					45	267	7	
Cheumatopsyche	48	14	63	23	1	94	1	3
Diplectrona	9	7				44	7	
Dolophilodes			1					
Glossosoma				1				

Table 4.6-5. Continued.

Taxon	Total Number							
	2010[a]	2009[b]	2008[a]	2007[a]	2006[b]	2005[c]	2004[d]	2003[d]
Trichoptera (caddisflies)								
Hydropsyche	753	49	1438	779	9	341	18	1
Lepidostoma			1				1	
Lype	2							
Rhyacophila	1						1	
Coleoptera (beetles)								
Hydrophilidae								2
Optioservus	16		3	2				
Stenelmis			1			1		
Diptera (true flies)								
Antocha	2		2	1				
Bezzia	1						4	
Chelifera	4	19				1	5	
Chironomidae	995	230	1,230	774	1,022	1,261	608	183
Chrysops	1	1						
Clinocera	5			1				
Dasyhelea		1						
Dicranota	4		6	5	3	18	8	2
Hemerodromia	23	16	23	56	2	10	3	
Limnophora							1	
Monohelea				1				
Ormosia	1					1	3	3
Palpomyia gr.	2		2	3		4		1
Pericoma	1							
Probezzia	2						3	
Psychoda	1	4	2		10	3	3	
Simulium			1	1	1			
Tipula	3		6	2	1	13	20	21
Total Number	2,035	401	2,902	1,700	1,265	2,189	735	248
Species Richness	32	20	24	22	19	23	25	19

[a] three sampling events

[b] two sampling events

[c] six sampling events

[d] four sampling events

Table 4.6-6. Total number of macroinvertebrates collected at Station 109 in the Schuylkill River, 2003-2010.

Taxon	Total Number							
	2010[a]	2009[b]	2008[a]	2007[a]	2006[b]	2005[c]	2004[d]	2003[d]
Nematoda (round worms)	73	66	178	6		3		
Nemertea (ribbon worms)								
Prostoma	24	22	33	12	1	3		1
Tricladida (flat worms)								
Dugesia		1			2			
Veneroida (clams)								
Pisidium	22	6	2	5			1	1
Gastropoda (snails)								
Physa		1	1	3	1	3		
Oligochaeta (worms)	168		157					
Enchytraeidae	8	35	64	1			3	4
Lumbricina		25	32	42	48	41	108	172
Lumbriculidae		38					6	
Megadrili	115							
Naididae	60	4	1,216	2	1	7		
Tubificidae	2	67		5	10	3	2	21
Hydrachnidia			10					
Acari	2							
Isopoda (sowbugs)								
Caecidotea	439	62	132	501	46	533	146	83
Amphipoda (scuds)								
Crangonyx	471	62	79	432	80	244	75	38
Stygonectes						3		
Decapoda (crayfish)								
Cambarus				3	4	1	1	1
Orconectes	1							
Hirudinea (leeches)								
Erpobdella				1	2			
Mooreobdella								1
Ephemeroptera (mayflies)								
Acentrella	3	2	10	3		3		
Baetis	134	7	140	74		270	9	2
Epeorus						1		
Megaloptera (fishflies)								
Corydalus						1		
Nigronia					5	1	2	1
Sialis			1	1			2	5
Plecoptera (stoneflies)								
Allocapnia								1
Amphinemura							1	
Leuctra						6		
Sweltsa		1						
Trichoptera (caddisflies)								
Ceratopsyche						1,429	222	38
Cheumatopsyche		22	13	11	2	829	202	239
Diplectrona							4	
Glossosoma	7		2				2	

Table 4.6-6. Continued.

Taxon	Total Number 2010[a]	2009[b]	2008[a]	2007[a]	2006[b]	2005[c]	2004[d]	2003[d]
Trichoptera (caddisflies)								
Hydropsyche	872	601	448	804	22	356	370	190
Hydroptila								1
Rhyacophila				1				
Coleoptera (beetles)								
Dubiraphia				1	3	2		
Helichus	1							
Optioservus	3	1	3	4				
Promoresia							1	
Psephenus					1			1
Stenelmis		2			1		3	
Diptera (true flies)								
Antocha	9	1	5	2		8	4	
Chelifera		2					2	6
Chironomidae	919	993	1,994	2,296	1,968	3,888	2,449	748
Dicranota			1	1	7	1		1
Empididae							3	
Hemerodromia	3	8	8	11	28	7	8	19
Hexatoma			1					
Ormosia			1					
Palpomyia gr.		1			2			1
Pseudolimnophila								1
Psychoda						1		4
Simuliidae						846		
Simulium	1		8	55	16	4		
Tipula	1				1	3	12	
Tipulidae							3	
Total Number	3,338	2,030	4,539	4,277	2,251	8,497	3,641	1,580
Species Richness	22	24	24	25	22	27	26	25

[a] three sampling events

[b] two sampling events

[c] six sampling events

[d] four sampling events

Table 4.7-1. Measurements of daily total discharge, daily water surface elevation, and weekly dissolved oxygen made at the Tamaqua Water Authority's Still Creek Reservoir, May-November 2010.

Date		Totalized Flow (MG)	Reservoir Release Daily Flow (MG)	Weekly Dissolved Oxygen (mg/l)	Reservoir Water Surface Level* (feet)
5/27/2010		6220.3	0.0	-	-
5/28/2010		6240.1	19.8	-	1182.1
5/29/2010		6260.0	19.9	-	1181.1
5/30/2010		6277.9	17.9	-	1181.8
5/31/2010		6299.0	21.1	-	1181.6
6/1/2010		6303.0	4.0	-	1181.4
6/2/2010	A	-	-	-	-
6/3/2010	A	-	-	-	-
6/4/2010	A	-	-	-	-
6/5/2010	A	-	-	-	-
6/6/2010	A	-	-	-	-
6/7/2010	A	-	-	-	-
6/8/2010	A	-	-	-	-
6/9/2010	A	-	-	-	-
6/10/2010	A	-	-	-	-
6/11/2010	A	-	-	-	-
6/12/2010	A	-	-	-	-
6/13/2010	A	-	-	-	-
6/14/2010	A	-	-	-	-
6/15/2010	A	-	-	-	-
6/16/2010	A	-	-	-	-
6/17/2010	A	-	-	-	-
6/18/2010	A	-	-	-	-
6/19/2010	A	-	-	-	-
6/20/2010	A	-	-	-	-
6/21/2010	A	-	-	-	-
6/22/2010	A	-	-	-	-
6/23/2010	A	-	-	-	-
6/24/2010		6303.00	0.00	-	
6/25/2010		6323.60	20.60	-	1181.5
6/26/2010		6347.80	24.20	-	1181.3
6/27/2010		6372.70	24.90	-	1181.1
6/28/2010		6376.70	4.00	-	1180.8
6/29/2010	A	-	-	-	-

* Elevation above Mean Sea Level
A = Release Stopped

Table 4.7-1. Continued.

Date		Totalized Flow (MG)	Reservoir Release Daily Flow (MG)	Weekly Dissolved Oxygen (mg/l)	Reservoir Water Surface Level* (feet)
6/30/2010		6376.70	0.00	-	-
7/1/2010		6390.80	14.10	-	1180.8
7/2/2010		6411.60	20.80	-	1180.6
7/3/2010		6430.60	19.00	-	1180.4
7/4/2010		6449.90	19.30	-	1180.2
7/5/2010		6469.40	19.50	-	1180.0
7/6/2010		6487.70	18.30	-	1179.8
7/7/2010		6491.70	4.00	-	1179.5
7/8/2010	A	-	-	-	-
7/9/2010	A	-	-	-	-
7/10/2010	A	-	-	-	-
7/11/2010	A	-	-	-	-
7/12/2010	A	-	-	-	-
7/13/2010	A	-	-	-	-
7/14/2010	A	-	-	-	-
7/15/2010	A	-	-	-	-
7/16/2010	A	-	-	-	-
7/17/2010	A	-	-	-	-
7/18/2010	A	-	-	-	-
7/19/2010	A	-	-	-	-
7/20/2010	A	-	-	-	-
7/21/2010	A	-	-	-	-
7/22/2010	A	-	-	-	-
7/23/2010	A	-	-	-	-
7/24/2010	A	-	-	-	-
7/25/2010	A	-	-	-	-
7/26/2010	A	-	-	-	-
7/27/2010	A	-	-	-	-
7/28/2010	A	-	-	-	-
7/29/2010	A	-	-	-	-
7/30/2010	A	-	-	-	-
7/31/2010	A	-	-	-	-
8/1/2010	A	-	-	-	-
8/2/2010	A	-	-	-	-

* Elevation above Mean Sea Level
A = Release Stopped

Table 4.7-1. Continued.

Date		Totalized Flow (MG)	Reservoir Release Daily Flow (MG)	Weekly Dissolved Oxygen (mg/l)	Reservoir Water Surface Level* (feet)
8/3/2010	A	-	-	-	-
8/4/2010	A	-	-	-	-
8/5/2010		6491.70	0.00	-	
8/6/2010		6507.90	16.20	-	1179.0
8/7/2010		6530.40	22.50	-	1178.8
8/8/2010		6553.60	23.20	-	1178.6
8/9/2010		6575.50	21.90	-	1178.3
8/10/2010		6597.90	22.40	-	1178.5
8/11/2010		6618.50	20.60	-	1178.2
8/12/2010		6641.20	22.70	-	1178.0
8/13/2010		6664.00	22.80	-	1177.8
8/14/2010		6685.30	21.30	-	1177.6
8/15/2010		6708.90	23.60	-	1177.3
8/16/2010		6731.20	22.30	-	1177.1
8/17/2010		-	-	-	1176.9
8/18/2010	A	-	-	-	-
8/19/2010	A	-	-	-	-
8/20/2010	A	-	-	-	-
8/21/2010	A	-	-	-	-
8/22/2010	A	-	-	-	-
8/23/2010	A	-	-	-	-
8/24/2010	A	-	-	-	-
8/25/2010		6731.20	0.00	-	
8/26/2010		6749.00	17.80	-	1176.90
8/27/2010		6773.30	24.30	8.00	1176.65
8/28/2010		6797.70	24.40	-	1176.50
8/29/2010		6821.80	24.10	-	1176.10
8/30/2010		6845.80	24.00	-	1175.80
8/31/2010		6857.30	11.50	-	1175.50
9/1/2010		6868.80	11.50	-	1175.20
9/2/2010		6880.40	11.60	-	1174.80
9/3/2010		6893.10	12.70	-	1174.50
9/4/2010		6903.40	10.30	8.10	1174.20
9/5/2010		6914.60	11.20	-	1173.80

* Elevation above Mean Sea Level
A = Release Stopped

Table 4.7-1. Continued.

Date		Totalized Flow (MG)	Reservoir Release Daily Flow (MG)	Weekly Dissolved Oxygen (mg/l)	Reservoir Water Surface Level* (feet)
9/6/2010		6926.10	11.50	-	1173.50
9/7/2010		6937.50	11.40	-	1173.30
9/8/2010		6948.90	11.40	-	1173.20
9/9/2010		6959.90	11.00	-	1173.00
9/10/2010		6971.50	11.60	8.20	1172.80
9/11/2010		6982.60	11.10	-	1172.70
9/12/2010		6994.60	12.00	-	1172.55
9/13/2010		7006.60	12.00	-	1172.40
9/14/2010		7018.30	11.70	-	1172.30
9/15/2010		7030.00	11.70	-	1173.10
9/16/2010		7041.90	11.90	-	1172.90
9/17/2010		7053.40	11.50	8.7	1172.60
9/18/2010		7064.90	11.50	-	1172.50
9/19/2010		7076.90	12.00	-	1172.40
9/20/2010		7088.70	11.80	-	1172.30
9/21/2010		7100.40	11.70	-	1172.10
9/22/2010		7112.10	11.70	-	1172.00
9/23/2010		7123.50	11.40	-	1171.90
9/24/2010		7135.50	12.00	8.4	1171.70
9/25/2010		7147.20	11.70	-	1172.60
9/26/2010		7159.10	11.90	-	1172.40
9/27/2010		7170.90	11.80	-	1171.20
9/28/2010		7182.70	11.80	-	1171.00
9/29/2010		7194.50	11.80	-	1170.90
9/30/2010	A	-	-	-	1170.80
10/1/2010	A	-	-	-	-
10/2/2010	A	-	-	-	-
10/3/2010	A	-	-	-	-
10/4/2010	A	-	-	-	-
10/5/2010	A	-	-	-	-
10/6/2010	A	-	-	-	-
10/7/2010	A	-	-	-	-
10/8/2010	A	-	-	-	-
10/9/2010	A	-	-	-	-

* Elevation above Mean Sea Level
A = Release Stopped

Table 4.7-1. Continued.

Date	Totalized Flow (MG)	Reservoir Release Daily Flow (MG)	Weekly Dissolved Oxygen (mg/l)	Reservoir Water Surface Level* (feet)
10/10/2010 A	-	-	-	-
10/11/2010 A	-	-	-	-
10/12/2010 A	-	-	-	-
10/13/2010 A	-	-	-	-
10/14/2010 A	-	-	-	-
10/15/2010 A	-	-	-	-
10/16/2010 A	-	-	-	-
10/17/2010 A	-	-	-	-
10/18/2010 A	-	-	-	-
10/19/2010 A	-	-	-	-
10/20/2010 A	-	-	-	-
10/21/2010 A	-	-	-	-
10/22/2010 A	-	-	-	-
10/23/2010 A	-	-	-	-
10/24/2010 A	-	-	-	-
10/25/2010 A	-	-	-	-
10/26/2010 A	-	-	-	-
10/27/2010 A	-	-	-	-
10/28/2010 A	-	-	-	-
10/29/2010 A	-	-	-	-
10/30/2010 A	-	-	-	-
10/31/2010 A	-	-	-	-
11/1/2010 A	-	-	-	-
11/2/2010 A	-	-	-	-
11/3/2010 A	-	-	-	-
11/4/2010 A	-	-	-	-
11/5/2010 A	-	-	-	-
11/6/2010 A	-	-	-	-
11/7/2010 A	-	-	-	-
11/8/2010 A	-	-	-	-
11/9/2010 A	-	-	-	-
11/10/2010 A	-	-	-	-
11/11/2010 A	-	-	-	-
11/12/2010 A	-	-	-	-

* Elevation above Mean Sea Level
A = Release Stopped

Table 4.7-1. Continued.

Date	Totalized Flow (MG)	Reservoir Release Daily Flow (MG)	Weekly Dissolved Oxygen (mg/l)	Reservoir Water Surface Level* (feet)
11/13/2010 A	-	-	-	-
11/14/2010 A	-	-	-	-
11/15/2010 A	-	-	-	-
11/16/2010 A	-	-	-	-
11/17/2010 A	-	-	-	-
11/18/2010 A	-	-	-	-
11/19/2010 A	-	-	-	-
11/20/2010 A	-	-	-	-
11/21/2010 A	-	-	-	-
11/22/2010 A	-	-	-	-
11/23/2010 A	-	-	-	-
11/24/2010 A	-	-	-	-
11/25/2010 A	-	-	-	-
11/26/2010 A	-	-	-	-
11/27/2010 A	-	-	-	-
11/28/2010 A	-	-	-	-
11/29/2010 A	-	-	-	-
11/30/2010 A	-	-	-	1175.50

* Elevation above Mean Sea Level
A = Release Stopped

Table 4.8-1. Water quality analyses of selected parameters measured in Little Schuylkill River downstream of the Still Creek confluence, in Still Creek, and in Little Schuylkill River upstream of Still Creek, April-November 2010.

Sample Date/Parameter[1]	Little Schuylkill River Downstream[2] (LSR2)	Still Creek[3] (SC1)	Little Schuylkill River Upstream[4] (LSR1)
4/30/2010			
Total Dissolved Solids	77	27	123
Total Alkalinity	4	6	<2
Dissolved Oxygen	10.4	9.8	10.5
Specific Conductance (µmhos/cm)	134	46	224
pH (Standard Units)	6.06	6.08	4.27
Temperature (°C)	10.9	12.4	10.2
5/28/2010			
Total Dissolved Solids	52	22	170
Total Alkalinity	4	4	<2
Dissolved Oxygen	9.6	9.5	9.9
Specific Conductance (µmhos/cm)	192	44	249
pH (Standard Units)	5.77	5.42	3.81
Temperature (°C)	14.9	11.9	13.0
6/23/2010			
Total Dissolved Solids	131	60	229
Total Alkalinity	2	19	<2
Dissolved Oxygen	9.0	8.4	9.7
Specific Conductance (µmhos/cm)	218	78	310
pH (Standard Units)	5.12	5.98	3.62
Temperature (°C)	17.8	17.2	15.0
7/29/2010			
Total Dissolved Solids	115	32	189
Total Alkalinity	4	18	<2
Dissolved Oxygen	8.5	8.7	9.1
Specific Conductance (µmhos/cm)	227	74	315
pH (Standard Units)	5.90	6.25	3.82
Temperature (°C)	20.6	20.0	16.6

Table 4.8-1. Continued.

Sample Date/Parameter[1]	Little Schuylkill River Downstream[2] (LSR2)	Still Creek[3] (SC1)	Little Schuylkill River Upstream[4] (LSR1)
<u>8/27/2010</u>			
Total Dissolved Solids	80	56	277
Total Alkalinity	6	6	<2
Dissolved Oxygen	8.7	7.9	9.7
Specific Conductance (µmhos/cm)	72	46	317
pH (Standard Units)	5.68	5.66	3.88
Temperature (°C)	20.5	20.5	14.1
<u>9/24/2010</u>			
Total Dissolved Solids	47	31	205
Total Alkalinity	6	3	<2
Dissolved Oxygen	9.7	9.3	12.6
Specific Conductance (µmhos/cm)	118	90	304
pH (Standard Units)	6.01	6.37	3.84
Temperature (°C)	18.5	19.0	13.9
<u>10/28/2010</u>			
Total Dissolved Solids	56	37	86
Total Alkalinity	4	23	<2
Dissolved Oxygen	10.2	5.9	9.8
Specific Conductance (µmhos/cm)	174	74	235
pH (Standard Units)	5.79	5.71	4.14
Temperature (°C)	11.3	11.3	11.5
<u>11/30/2010</u>			
Total Dissolved Solids	69	10	98
Total Alkalinity	2	14	<2
Dissolved Oxygen	11.7	9.7	11.0
Specific Conductance (µmhos/cm)	170	67	225
pH (Standard Units)	5.29	6.33	4.20
Temperature (°C)	5.3	5.3	7.1

[1] Concentration in mg/l unless otherwise indicated
[2] Little Schuylkill River downstream, just below PA Route 54 bridge
[3] Still Creek upstream of PA Route 309 bridge
[4] Little Schuylkill River upstream, just below SR1020 bridge

Table 4.8-2. Aquatic habitat observations and water quality data for Still Creek, Little Schuylkill River (LSR) upstream of Still Creek, LSR downstream of Still Creek at the Route 54 bridge, and LSR near Tamaqua, April-November 2010.

Date*	Site	Dissoved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Temperature (°C)	pH (Standard Units)	Comments/Observation
4/26/2009	LSR - Tamaqua[1]	10.8	117	9.5	6.81	water clear, rocky bottom, no algal growth, moderate flow, nothing abnormal
	LSR - Downstream[2]	10.4	134	10.9	6.06	water clear, rocky bottom, no algal growth, moderate flow, nothing abnormal
	LSR - Upstream[3]	10.5	224	10.2	4.27	water clear, rocky bottom, green algal growth, iron staining, moderate flow
	Still Creek[4]	9.8	46	12.4	6.08	water clear, no algal growth, moderate flow, nothing abnormal
5/28/2010	LSR - Tamaqua[1]	9.0	108	17.1	6.32	water clear, rocky bottom, no algal growth, moderate flow, nothing abnormal
	LSR - Downstream[2]	9.6	192	14.9	5.77	water clear, rocky bottom, no algal growth, moderate flow, nothing abnormal
	LSR - Upstream[3]	9.9	249	13.0	3.81	water clear, rocky bottom, green algal growth, iron staining, low flow
	Still Creek[4]	9.5	44	11.9	5.42	water clear, no algal growth, reservoir releasing, nothing abnormal
6/23/2010	LSR - Tamaqua[1]	8.8	180	18.8	6.88	water clear, rocky bottom, no algal growth, low flow, nothing abnormal
	LSR - Downstream[2]	9.0	218	17.8	5.12	water clear, rocky bottom, no algal growth, low flow, nothing abnormal
	LSR - Upstream[3]	9.7	310	15.0	3.62	water clear, rocky bottom, green algal growth, iron staining, low flow
	Still Creek[4]	8.4	78	17.2	5.98	water clear, no algal growth, very little flow, discharge off, nothing abnormal
7/29/2010	LSR - Tamaqua[1]	8.6	179	21.9	7.03	water clear, rocky bottom, no algal growth, low flow, nothing abnormal
	LSR - Downstream[2]	8.5	227	20.6	5.90	water clear, rocky bottom, brown algal growth, low flow, nothing abnormal
	LSR - Upstream[3]	9.1	315	16.6	3.82	water clear, rocky bottom, no algal growth, iron staining, low flow
	Still Creek[4]	8.7	74	20.0	6.25	water clear, no algal growth, very little flow, discharge off, nothing abnormal
8/27/2010	LSR - Tamaqua[1]	9.2	81	16.8	6.35	water clear, rocky bottom, no algal growth, mod. flow, nothing abnormal
	LSR - Downstream[2]	8.7	72	20.5	5.68	water clear, rocky bottom, brown algal growth, mod flow, nothing abnormal
	LSR - Upstream[3]	9.7	317	14.1	3.88	water clear, rocky bottom, no algal growth, iron staining, low flow
	Still Creek[4]	7.9	46	20.5	5.66	water clear, no algal growth, reservoir releasing, nothing abnormal
9/24/2010	LSR - Tamaqua[1]	9.9	155	17.6	6.57	water clear, rocky bottom, no algal growth, mod. flow, nothing abnormal
	LSR - Downstream[2]	9.7	118	18.5	6.01	water clear, rocky bottom, brown algal growth, mod flow, nothing abnormal
	LSR - Upstream[3]	12.6	304	13.9	3.84	water clear, rocky bottom, no algal growth, iron staining, low flow
	Still Creek[4]	9.3	90	19.0	6.37	water clear, no algal growth, reservoir releasing, nothing abnormal
10/28/2010	LSR - Tamaqua[1]	9.8	139	12.1	6.51	water clear, rocky bottom, no algal growth, mod. flow, nothing abnormal
	LSR - Downstream[2]	10.2	174	11.3	5.79	water clear, rocky bottom, no algal growth, mod flow, nothing abnormal
	LSR - Upstream[3]	9.8	235	11.5	4.14	water clear, rocky bottom, no algal growth, iron staining, mod flow
	Still Creek[4]	5.9	74	11.3	5.71	water clear, no algal growth, very low flow, heavy leaves hindering flow

Table 4.8-2. Continued.

Date*	Site	Dissoved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Temperature (°C)	pH (Standard Units)	Comments/Observation
11/30/2010	LSR - Tamaqua[1]	11.6	129	5.3	6.27	water clear, rocky bottom, no algal growth, mod. flow, nothing abnormal
	LSR - Downstream[2]	11.7	170	5.3	5.29	water clear, rocky bottom, no algal growth, mod flow, nothing abnormal
	LSR - Upstream[3]	11.0	225	7.1	4.20	water clear, rocky bottom, no algal growth, iron staining, mod flow
	Still Creek[4]	9.7	67	5.3	6.33	water clear, no algal growth, low flow, nothing abnormal

[1] Little Schuylkill River - Tamaqua, downstream of Tuscarora Road Bridge

[2] Little Schuylkill River - Downstream, just below PA Route 54 Bridge

[3] Little Schuylkill River - Upstream, just below SR1020 Bridge

[4] Still Creek - Upstream of PA Route 309 Bridge

Table 4.9-1. Fish captured by electrofishing in the Little Schuylkill River near Hometown (SR 54), Pennsylvania in 2010.

		April 2010				August 2010				September 2010			
		Little Schuylkill River Above Pine Creek		Little Schuylkill River Below Still Creek		Little Schuylkill River Above Pine Creek		Little Schuylkill River Below Still Creek		Little Schuylkill River Above Pine Creek		Little Schuylkill River Below Still Creek	
Scientific Name	Common Name	Total No.	Length Range (mm)	Total No.	Length Range (mm)	Total No.	Length Range (mm)	Total No.	Length Range (mm)	Total No.	Length Range (mm)	Total No.	Length Range (mm)
Salvelinus fontinalis	brook trout (wild)	13	84-243	2	177-185	9	53-240			9	98-250	2	177-208
Salvelinus fontinalis	brook trout (hatchery)	1	295										
Salmo trutta	brown trout (hatchery)									1	252		
Catostomus commersoni	white sucker	2	166-167							10	140-225		
Lepomis macrochirus	bluegill					1	35						
Lepomis hybrid	sunfish hybrid												
Esox miger	chain pickerel	1	107										
Semotilus atromaculatus	creek chub					1	87			4	105-120		
Perca flavescens	Yellow perch	2	95-101	1	103			1	125				
	Total Species:	4		2		3		1		4		1	
	Total Individuals:	19		3		11		1		24		2	
Time:		9:55		12:07		9:25		12:00		10:15		11:35	
Water Temperature (°C)		8.9		11.2		18.7		19.3		17.1		18.5	
Dissolved Oxygen (mg/l)		11.2		10.7		9.9		9.0		10.4		8.8	
pH: (Standard Units)		5.6		5.1		6.0		5.7		5.9		5.8	
Specific Conductance (µmhos/cm@k25)		157		140		55		48		115		59	

Table 4.10-1. Montly water quality measurements made in the Perkiomen Creek near the East Branch Perkiomen Creek confluence, April-November 2010.

Sample Date	Dissolved Oxygen (mg/l)	Temperature (°C)	*E. coli* (mpn/100ml)	Fecal Coliforms (no./100ml)
Perkiomen Creek upstream of East Branch confluence, Rt 73 Bridge Schwenksville				
April 23	10.6	15.0	31	46
May 13	11.4	14.9	120	200
June 8	9.4	23.0	93	230
July 13	8.5	23.4	410	530
August 3	10.2	26.1	40	98
September 21	9.9	21.3	25	100
October 5	9.5	15.1	690	690
November 2	12.9	9.1	130	130
April-November 2010				
Min	8.5	9.1	25	46
Max	12.9	26.1	690	690
Mean	10.3	18.5	192	253
April-November 2009				
Min	8.0	11.6	38	39
Max	11.4	26.7	690	880
Mean	9.9	18.3	223	274
April-December 2008				
Min	8.5	4.9	14	21
Max	13.9	25.0	360	900
Mean	11.3	17.0	116	219
May-November 2007				
Min	7.9	6.0	26	28
Max	12.0	28.8	690	700
Mean	10.0	18.7	205	265
April-October 2006				
Min	8.5	15.2	39	46
Max	11.5	28.1	280	440
Mean	10.0	20.2	108	222
April-October 2005				
Min	8.7	14.3	11	16
Max	13.7	28.0	870	3000
Mean	10.7	21.0	290	636
May-October 2004				
Min	8.8	12.3	39	80
Max	11.0	26.0	308	400
Mean	10.0	22.4	130	179
July-October 2003				
Min	8.7	15.4	18	56
Max	11.8	26.4	1100	2000
Mean	9.8	22.2	319	559

Table 4.10-1. Continued.

Sample Date	Dissolved Oxygen (mg/l)	Temperature (°C)	*E. coli* (mpn/100ml)	Fecal Coliforms (no./100ml)
Perkiomen Creek downstream of East Branch confluence, Grateford Intake Pumphouse				
April 23	10.8	15.3	20	21
May 13	11.5	16.2	280	290
June 8	9.5	22.0	39	140
July 13	7.5	23.9	1300	5600
August 3	8.6	26.0	25	56
September 21	9.9	19.5	26	54
October 5	9.9	14.4	550	2500
November 2	13.1	8.1	28	40
<u>April-November 2010</u>				
Min	7.5	8.1	20	21
Max	13.1	26.0	1300	5600
Mean	10.1	18.2	284	1088
<u>April-November 2009</u>				
Min	7.7	12	35	52
Max	12	27.2	2400	3100
Mean	9.7	18.5	464	600
<u>April-December 2008</u>				
Min	7.0	5.4	5	6
Max	14.9	23.9	290	350
Mean	11.3	16.8	100	149
<u>May-November 2007</u>				
Min	7.2	5.4	32	92
Max	10.3	28.1	280	300
Mean	9.1	18.7	120	162
<u>April-October 2006</u>				
Min	7.4	15.0	20	32
Max	10.2	28.6	410	420
Mean	9.2	20.3	149	212
<u>April-October 2005</u>				
Min	7.0	13.6	15	26
Max	14.2	28.2	920	1000
Mean	9.9	21.4	241	328
<u>May-October 2004</u>				
Min	7.7	12.3	30	80
Max	10.1	26.5	579	1055
Mean	9.2	22.8	207	318
<u>July-October 2003</u>				
Min	8.1	15.3	21	60
Max	12.7	25.9	1100	1500
Mean	10.0	21.7	305	435

Table 4.11-1. Water quality measurements made in the Bradshaw Reservoir outfall to East Branch Perkiomen Creek and at three locations in East Branch Perkiomen Creek, April-November 2010.

	200 ft. Upstream of Bradshaw Outfall				Outfall from Bradshaw Reservoir				Downstream at Bucks Road USGS gage				Downstream at Rt. 73 Bridge			
Sample Date	Dissolved Oxygen (mg/l)	Temp (°C)	*E. coli* (mpn/ 100ml)	Fecal Coliforms (no./100ml)	Dissolved Oxygen (mg/l)	Temp (°C)	*E. coli* (mpn/ 100ml)	Fecal Coliforms (no./100ml)	Dissolved Oxygen (mg/l)	Temp (°C)	*E. coli* (mpn/ 100ml)	Fecal Coliforms (no./100ml)	Dissolved Oxygen (mg/l)	Temp (°C)	*E. coli* (mpn/ 100ml)	Fecal Coliforms (no./100ml)
4/20/2010	11.4	10.9	68	70	10.0	13.2	3	6	11.1	14.1	12	13	10.4	15.1	30	48
4/22/2010	10.3	13.0	59	78	10.2	14.4	5	6	11.4	15.6	32	34	10.2	17.1	70	74
4/28/2010	14.3	8.7	200	370	13.0	12.4	120	210	13.6	12.1	110	120	13.8	11.7	200	210
5/10/2010	10.4	10.2	160	170	10.5	15.6	6	8	10.0	15.3	32	34	10.6	13.8	55	60
5/11/2010	11.4	11.7	110	140	11.0	15.3	1	6	10.3	15.1	28	34	11.3	14.4	20	42
5/13/2010	10.7	12.5	1200	1200	11.6	13.9	1	<2	10.7	15.7	80	94	11.4	16.2	86	92
5/25/2010	12.7	22.6	64	76	15.9	21.4	4	8	13.8	22.5	230	240	12.8	25.3	13	31
5/27/2010	10.2	21.5	110	110	10.5	23.1	3	11	10.3	22.8	310	410	11.1	24.5	57	66
6/8/2010	6.8	17.6	190	260	9.2	23.7	2	2	8.9	23.8	66	74	11.2	22.6	16	44
6/10/2010	8.1	19.9	>2400	14000	9.3	21.7	13	15	9.0	22.9	410	420	10.7	22.8	490	510
6/15/2010	8.6	22.1	420	510	9.0	23.5	22	26	8.8	24.5	88	88	9.9	25.0	110	200
6/16/2010	7.8	19.9	190	210	9.4	23.0	14	15	8.8	22.7	91	98	8.8	22.8	41	130
6/17/2010	8.0	21.3	580	590	9.2	23.4			8.6	23.7	77	84	9.9	24.9	110	110
7/2/2010	6.6	16.8	200	530	9.5	24.0	<1	<2	9.5	22.7	72	72	9.3	19.9	17	42
7/13/2010	6.4	22.5	>2400	>6000	8.4	25.5	38	74	7.5	24.8	>2400	7200	8.5	24.3	980	2800
7/15/2010	6.2	23.5	870	1300	8.6	25.4	19	30	8.2	26.0	72	88	8.6	25.2	190	510
7/16/2010	4.6	24.4	610	1000	8.4	26.7	16	30	7.8	26.3	150	200	7.7	26.1	68	210
7/27/2010	6.4	24.5	330	380	8.3	28.2	4	10	8.5	29.4	72	250	10.5	28.0	4	260
8/3/2010	9.8	28.7	61	120	8.9	26.6	12	15	8.9	27.3	140	140	11.0	26.3	2	16
8/4/2010	9.1	29.2	69	140	8.8	27.1	6	8	8.8	27.9	49	74	10.6	28.2	8	16
8/5/2010	7.7	28.1	>2400	5700	8.6	27.5	5	33	8.2	27.7	52	54	9.4	28.0	40	50
8/10/2010	3.7	23.6	310	330	8.6	27.7	3	6	8.5	27.3	47	56	10.5	27.4	57	110
8/26/2010	6.6	21.3	46	48	9.3	23.7	8	11	9.1	24.2	42	58	10.8	24.0	24	26
9/15/2010	4.4	15.2	62	64	9.7	20.4	2	2	9.3	20.8	17	18	10.3	18.9	18	48
9/21/2010	*	*	*	*	9.6	20.8	3	6	9.8	21.2	14	16	10.3	19.3	11	31
9/22/2010	*	*	*	*	9.5	21.1	7	8	9.2	21.3	15	28	9.8	20.7	17	36
9/23/2010	*	*	*	*	9.7	22.4	3	3	9.5	22.6	30	30	9.7	22.3	260	370
9/24/2010	*	*	*	*	9.4	21.7	2	15	8.7	21.7	40	42	8.0	21.0	120	120
10/5/2010	9.4	13.2	1400	1500	8.2	16.8	170	200	9.6	15.8	280	330	10.1	14.1	330	800
10/6/2010	8.9	13.7	1600	2200	9.3	15.9	160	190	9.3	15.3	460	470	9.8	14.1	610	2100
10/14/2010	11.2	12.0	1300	1300	9.5	16.5	88	120	10.5	15.6	150	160	11.2	13.5	120	120
10/19/2010	9.6	11.1	460	470	10.0	13.5	170	170	10.2	13.1	150	200	10.8	12.5	130	240
10/20/2010	11.5	10.3	260	370	10.2	13.5	100	120	11.3	12.6	110	110	12.1	11.8	96	98

Table 4.11-1. Continued.

Sample Date	200 ft. Upstream of Bradshaw Outfall				Outfall from Bradshaw Reservoir				Downstream at Bucks Road USGS gage				Downstream at Rt. 73 Bridge			
	Dissolved Oxygen (mg/l)	Temp (°C)	*E. coli* (mpn/ 100ml)	Fecal Coliforms (no./100ml)	Dissolved Oxygen (mg/l)	Temp (°C)	*E. coli* (mpn/ 100ml)	Fecal Coliforms (no./100ml)	Dissolved Oxygen (mg/l)	Temp (°C)	*E. coli* (mpn/ 100ml)	Fecal Coliforms (no./100ml)	Dissolved Oxygen (mg/l)	Temp (°C)	*E. coli* (mpn/ 100ml)	Fecal Coliforms (no./100ml)
11/2/2010	12.5	6.5	50	90	10.5	12.7	47	50	11.6	11.1	43	56	13.9	7.6	7	8
11/3/2010	12.6	5.7	25	26	10.5	11.3	44	66	11.9	10.9	38	54	14.0	6.9	15	15
11/11/2010	13.6	5.5	84	230	12.2	8.7	140	140	13.3	8.5	77	82	13.4	7.1	47	52
11/17/2010	9.3	11.7	>2400	9100	10.6	10.8	68	120	11.1	11.5	>2400	4400	11.5		690	1100
11/18/2010	11.1	8.5	550	600	10.6	10.5	110	130	12.3	10.0	120	150	12.6	10.0	190	190
April-November 2010																
Min	3.7	5.5	25	26	8.2	8.7	1	2	7.5	8.5	12	13	7.7	6.9	2	8
Max	14.3	29.2	>2400	14,000	15.9	28.2	170	210	13.8	29.4	>2400	7,200	14.0	28.2	980	2,800
Mean	9.2	16.7	388	1,312	9.9	19.6	39	53	9.9	19.6	106	423	10.7	19.3	141	289
April-November 2009																
Min	7.2	9.1	63	72	7.4	11.8	1	2	7.0	11.7	7	10	7.7	10.7	6	20
Max	15.1	25.1	1700	51000	14.5	26.3	140	210	14.6	26.2	1200	18000	13.9	28.1	2000	31000
Mean	9.3	17.1	338	5165	9.6	19.4	30	39	9.2	19.5	130	1119	10.1	19.4	158	1563
April-December 2008																
Min	2.4	1.2	7	23	6.1	4.0	1	2	5.8	3.9	10	11	7.3	1.3	3	10
Max	13.3	23.3	>2400	17000	14.9	26.5	1200	2400	13.4	26.8	>2400	3500	14.2	28.5	2000	3000
Mean	7.4	14.9	375	1482	10.0	18.3	107	191	9.8	18.6	148	284	10.7	17.8	116	178
May-November 2007																
Min	4.5	3.3	27	3	7.9	8.9	1	2	7.1	8.8	11	18	8.2	4.5	4	15
Max	12.1	24.6	>2400	2800	12.5	28.0	>2400	>600	13.2	28.2	>2400	1200	12.5	29.1	1400	1500
Mean	7.3	16.7	488	616	9.5	21.3	48	53	9.1	21.2	108	157	10.0	20.3	105	124
April-October 2006																
Min	4.7	8.2	18	22	8.1	13.0	<1	<2	7.3	11.2	21	28	7.9	11.7	10	20
Max	10.7	27.5	>2400	4700	11.5	28.4	310	470	11.0	29.9	980	1500	12.1	32.5	1600	2200
Mean	8.8	18.0	338	587	9.6	20.5	42	70	9.2	20.8	118	154	9.8	20.9	157	240
April-October 2005																
Min	5.5	10.2	32	40	8.2	12.1	1	2	7.7	12.2	6	12	8.2	12.5	10	10
Max	13.8	26.2	1000	1600	13.9	28.7	650	860	13.2	29.8	330	470	13.3	31.0	310	1300
Mean	8.2	18.6	310	442	10.1	21.6	46	63	9.8	21.9	79	110	10.8	21.9	68	129
May-October 2004																
Min	4.8	8.7	54	70	8.2	12.2	1	2	7.2	11.7	10	13	8.3	10.4	8	15
Max	10.9	23.9	2420	1700	11.0	26.0	816	860	11.8	27.6	687	1000	11.1	27.6	1120	2600
Mean	8.9	18.7	486	528	9.7	20.3	71	91	9.1	20.7	87	117	9.7	21.4	159	261

* stream dry at time of sampling

Table 4.12-1. Mean monthly discharge of East Branch Perkiomen Creek measured at the USGS Bucks Road gage, 1989-2010.

Year	Mean Monthly Discharge (cfs)												Mean
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1989										24	28	23	25
1990	23	15	42	21	40	51	45	59	57	57	13	24	37
1991	20	12	17	26	42	49	54	58	58	57	60	47	42
1992	20	13	17	16	35	35	51	56	55	48	34	24	34
1993	18	23	43	30	35	57	52	62	56	55	42	25	42
1994	20	17	42	19	44	61	61	61	56	56	41	15	41
1995	20	16	29	29	56	59	62	54	53	57	38	17	41
1996	41	21	25	28	32	55	57	57	57	59	38	40	42
1997	20	25	22	32	60	56	60	60	60	60	46	33	44
1998	26	26	24	25	45	48	65	62	60	61	60	58	47
1999	41	22	26	40	47	60	58	57	73	51	37	36	46
2000	29	26	26	19	58	61	64	65	62	62	56	44	48
2001	24	28	27	27	67	70	67	64	62	62	59	46	50
2002	48	30	24	43	48	66	61	62	47	47	27	26	44
2003	17	23	31	22	58	45	61	40	43	40	24	33	36
2004	17	23	20	29	31	30	41	35	41	23	23	23	28
2005	23	20	22	29	16	13	16	19	33	30	24	22	22
2006	27	20	17	17	23	35	22	16	20	23	30	19	22
2007	24	16	28	36	18	17	23	32	31	34	17	27	25
2008	17	31	28	16	20	15	26	37	28	27	24	34	25
2009	8	17	17	18	21	24	16	22	18	24	17	31	19
2010	21	22	44	20	19	16	20	24	38	23	19	35	25
Mean	24	21	27	26	39	44	47	48	48	45	35	31	

Provisional data subject to revision

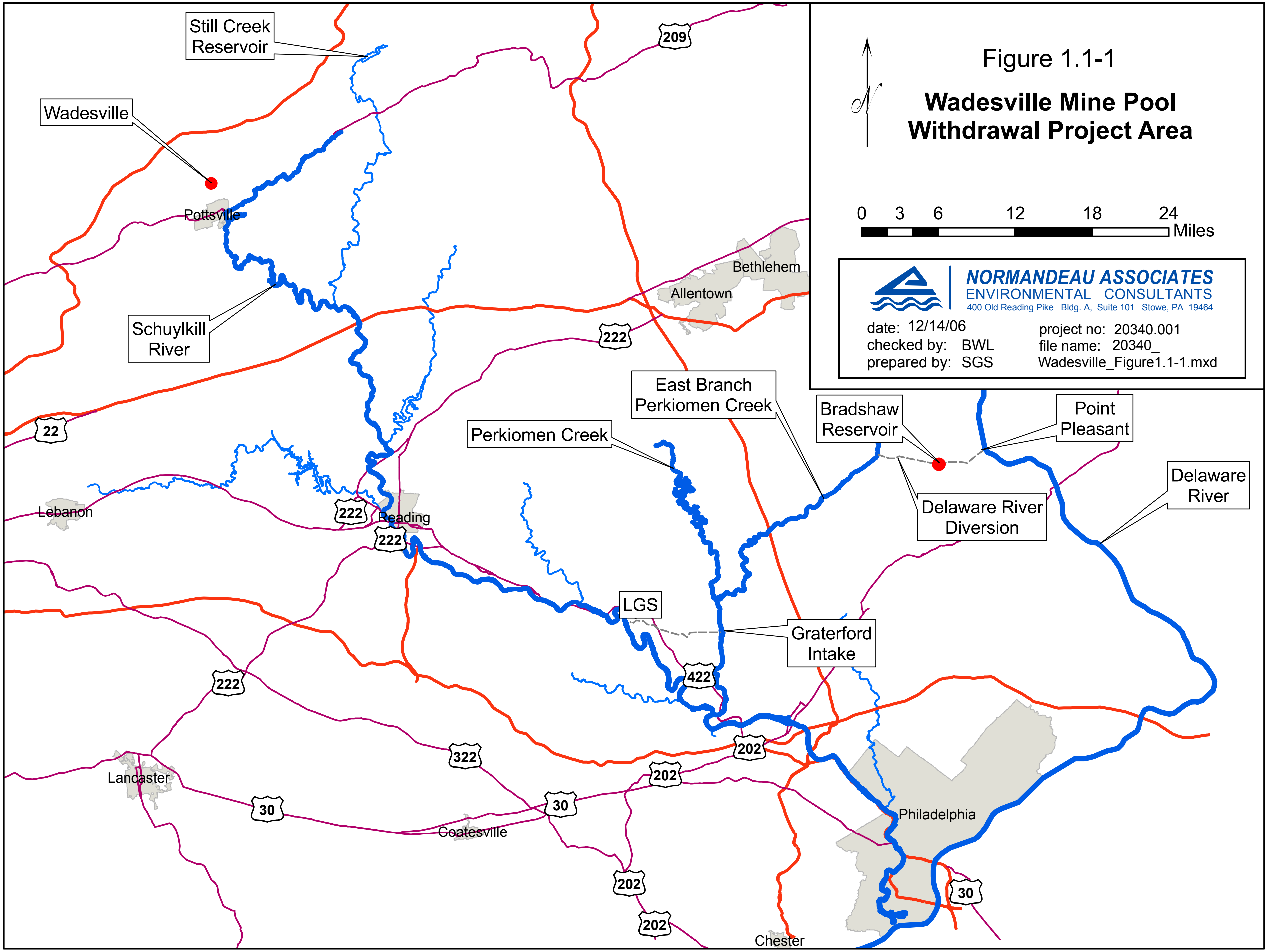


Figure 1.1-1
Wadesville Mine Pool Withdrawal Project Area
0 3 6 12 18 24 Miles
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS
400 Old Reading Pike Bldg. A, Suite 101 Stowe, PA 19464
date: 12/14/06
checked by: BWL
prepared by: SGS
project no: 20340.001
file name: 20340_Wadesville_Figure1.1-1.mxd
Still Creek Reservoir
Wadesville
Pottsville
Schuylkill River
Bethlehem
Allentown
East Branch Perkiomen Creek
Perkiomen Creek
Bradshaw Reservoir
Point Pleasant
Delaware River
Delaware River Diversion
Lebanon
Reading
LGS
Graterford Intake
Lancaster
Coatesville
Philadelphia
Chester
209
22
222
422
322
202
30

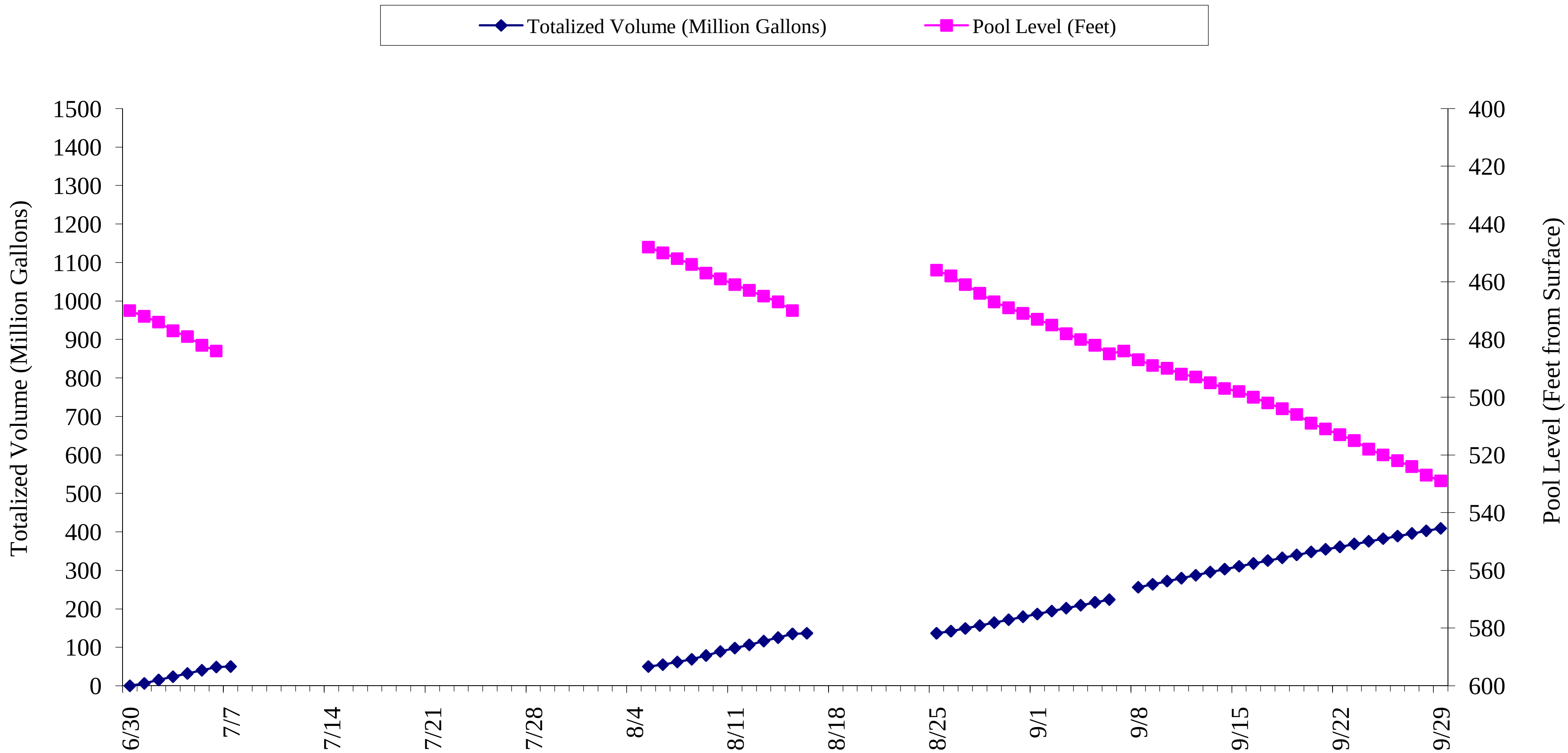


Figure 4.1-1. Totalized daily volume of water pumped and water level of the Wadesville Mine Pool, June-September 2010.

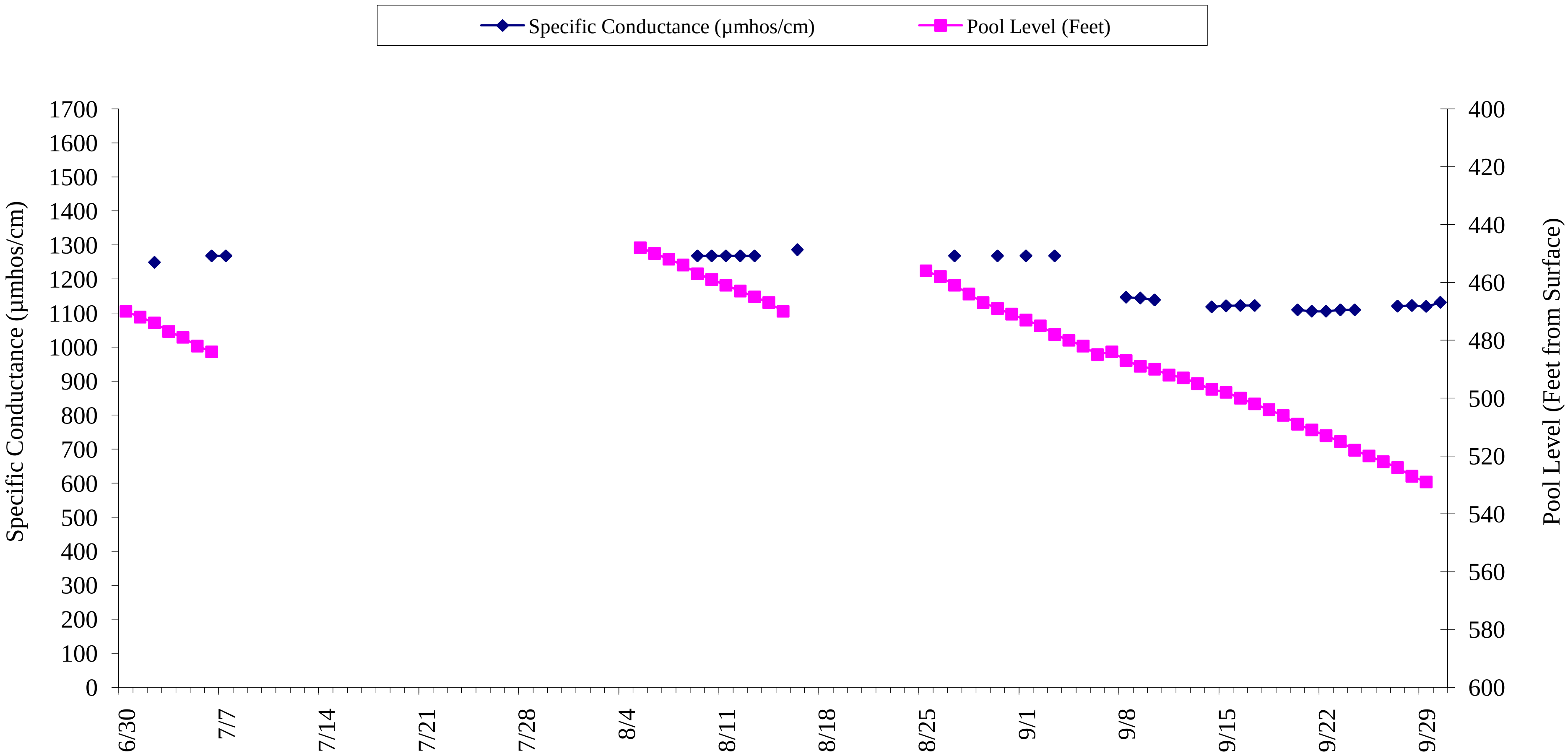


Figure 4.1-2. Specific conductance and pool level of the Wadesville Mine Pool, June-September 2010.

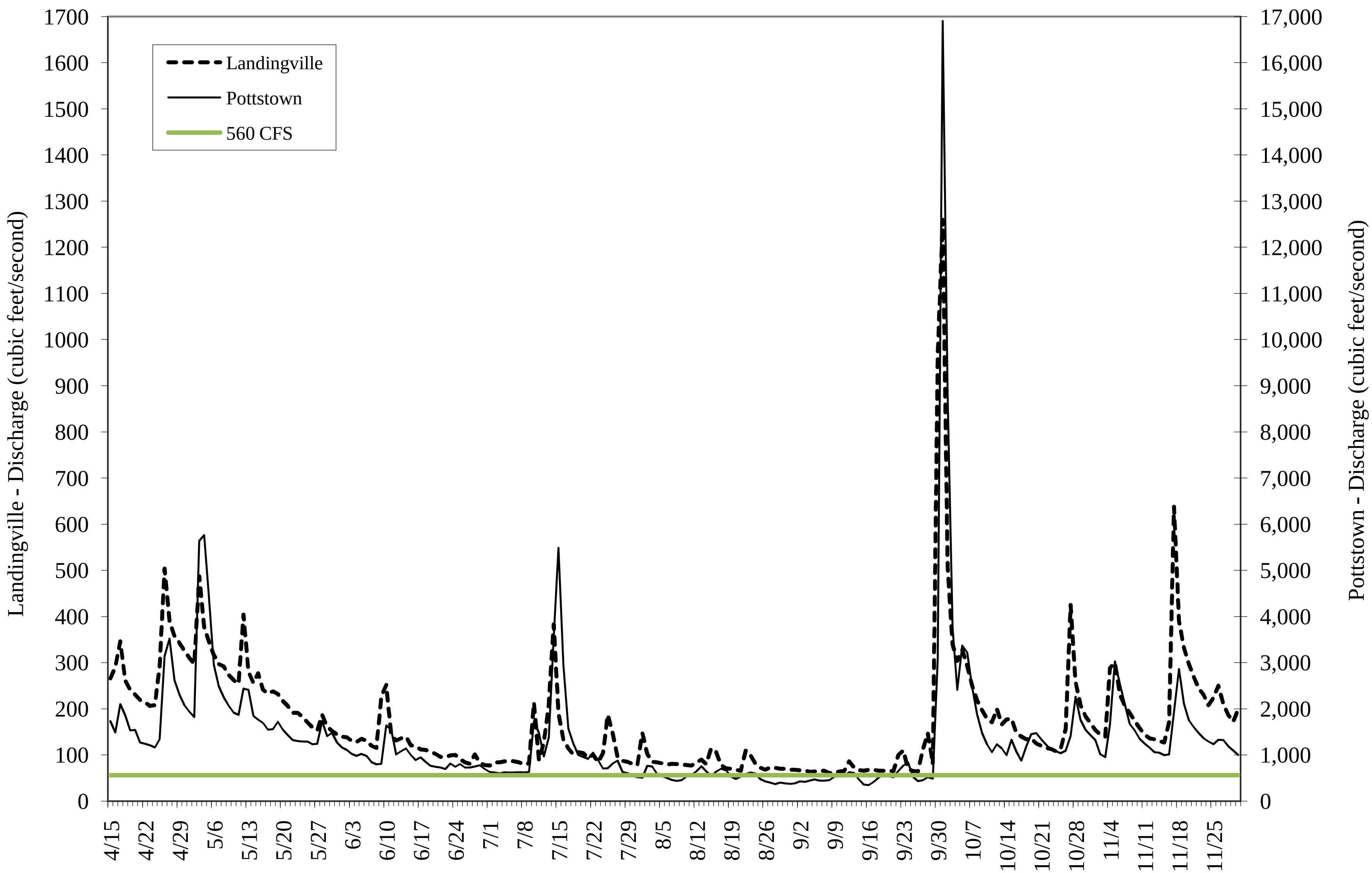
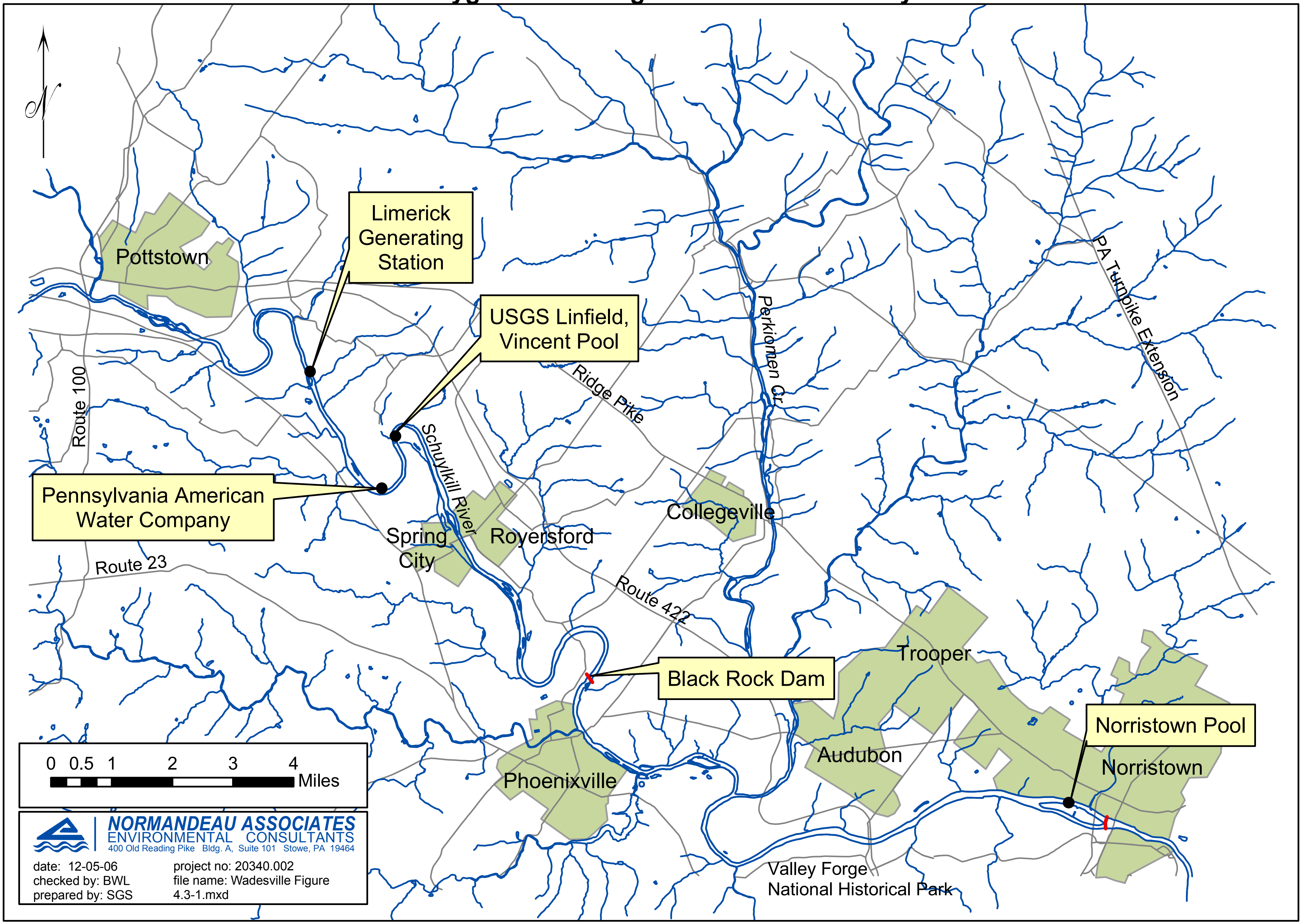


Figure 4.2-1. Daily mean discharge measured in the Schuylkill River at Landingville and Pottstown, April-November 2010.

Figure 4.3-1.

Dissolved Oxygen Monitoring Stations on the Schuylkill River.



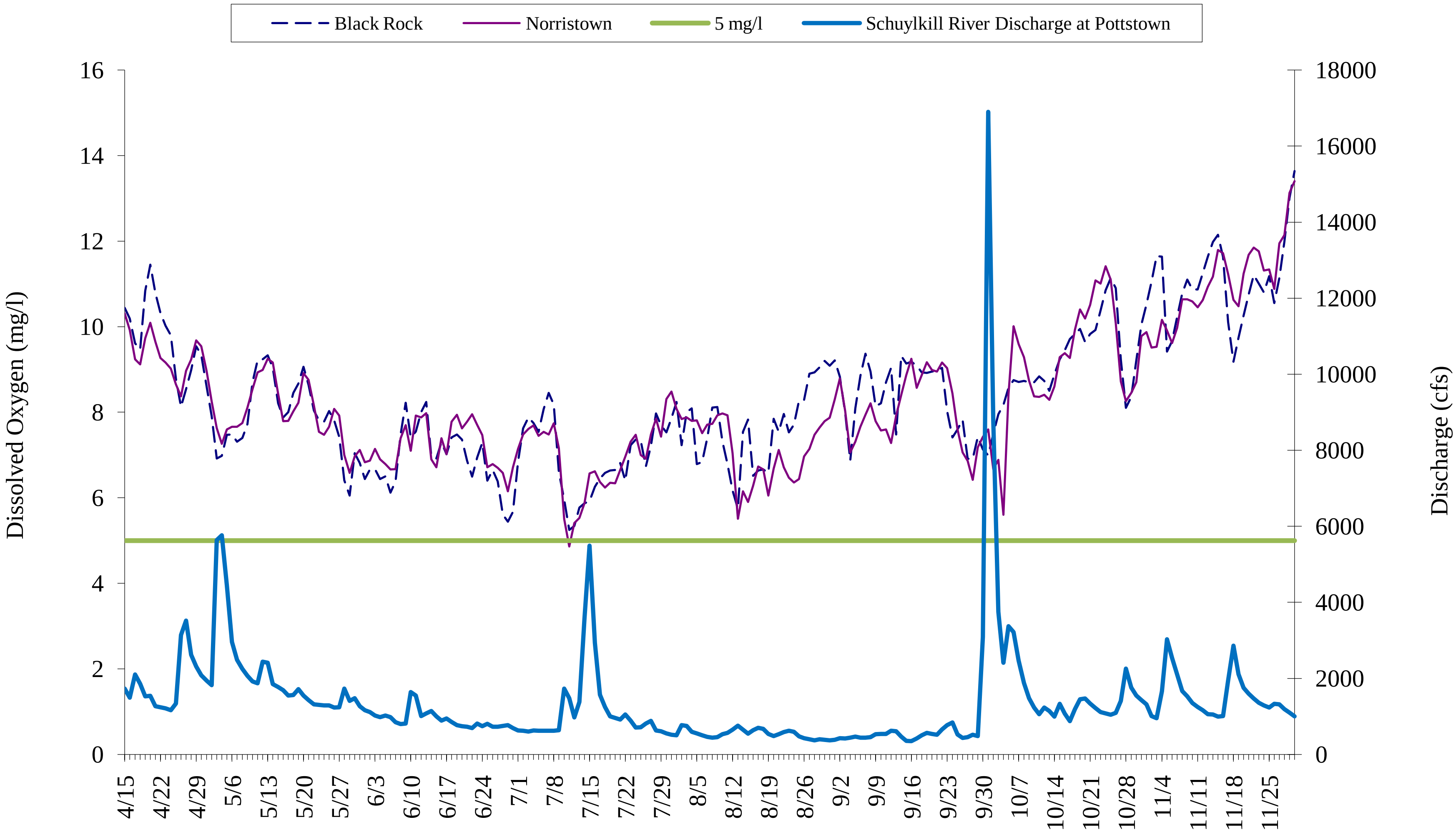


Figure 4.3-2. Mean daily dissolved oxygen measured in the Schuylkill River at Black Rock and Norristown stations and mean daily discharge measured at Pottstown, April-November 2010.

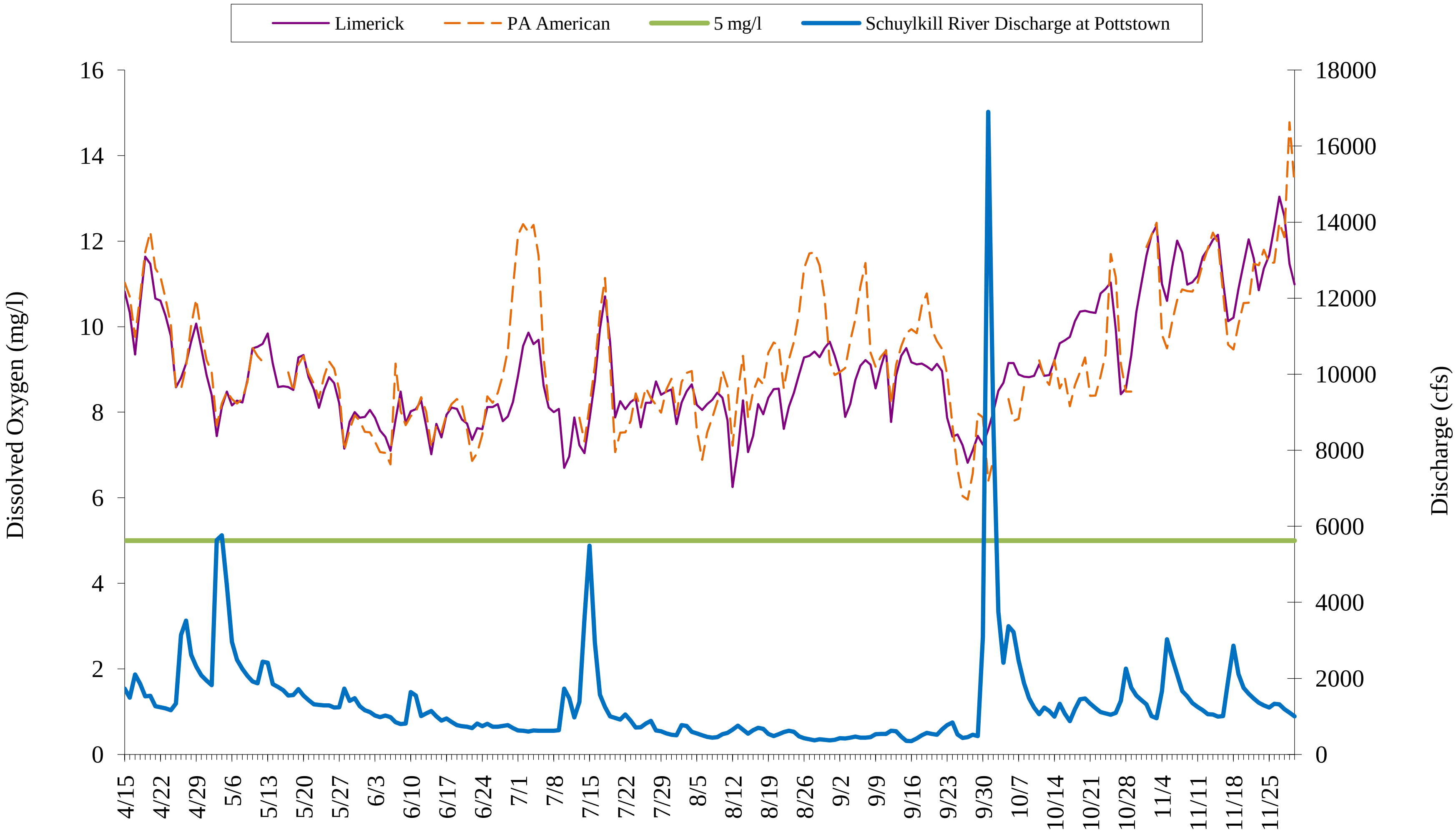


Figure 4.3-3. Mean daily dissolved oxygen measured in the Schuylkill River at Limerick and Pennsylvania American stations and mean daily discharge measured at Pottstown, April-November 2010.

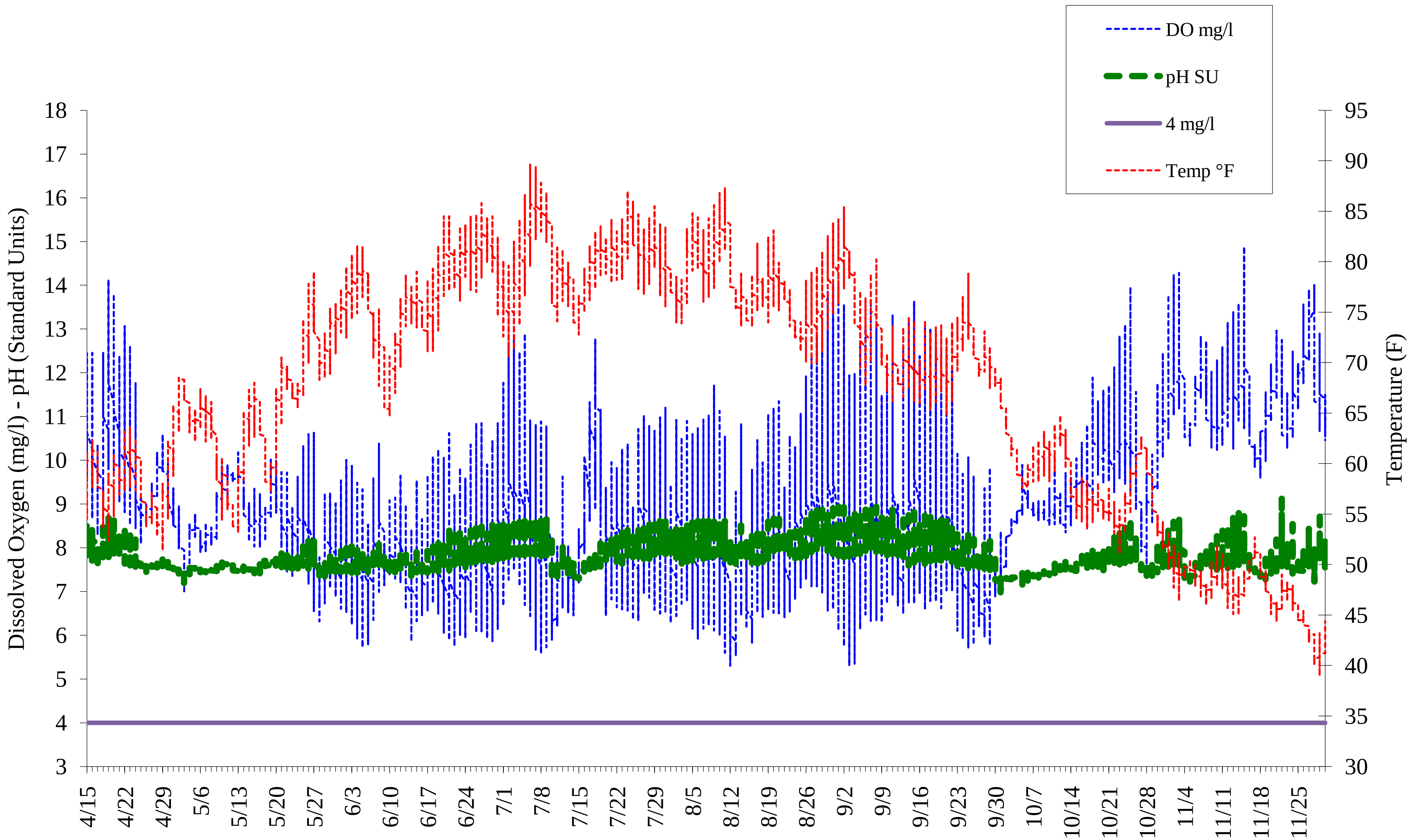


Figure 4.3-4. Hourly measurements of temperature, dissolved oxygen, and pH at the Limerick intake, April-November 2010.

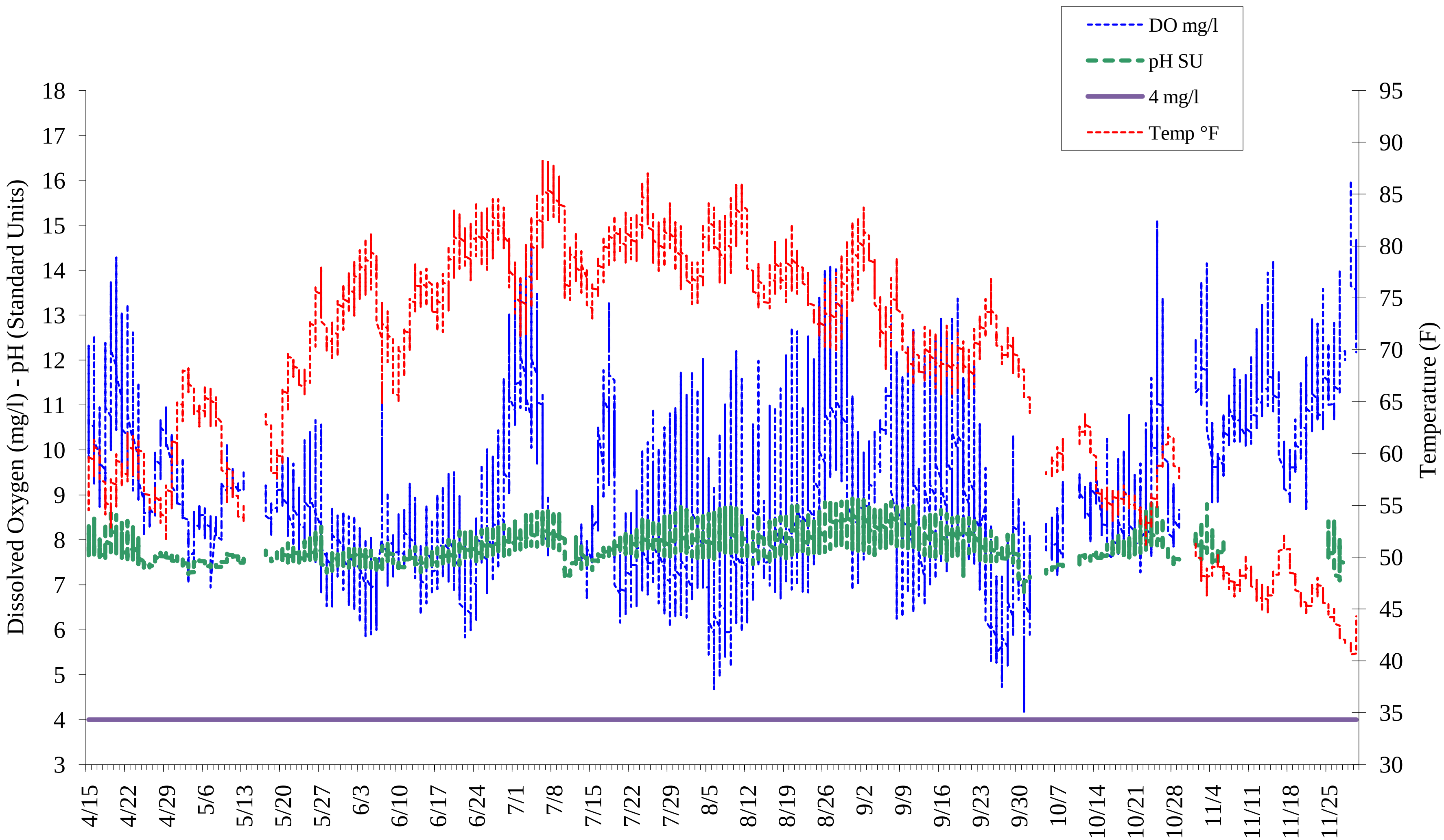


Figure 4.3-5. Hourly measurements of temperature, dissolved oxygen, and pH at the Pennsylvania American intake, April-November 2010.

Equipment failure October 8 through 11 and October 29 through 31

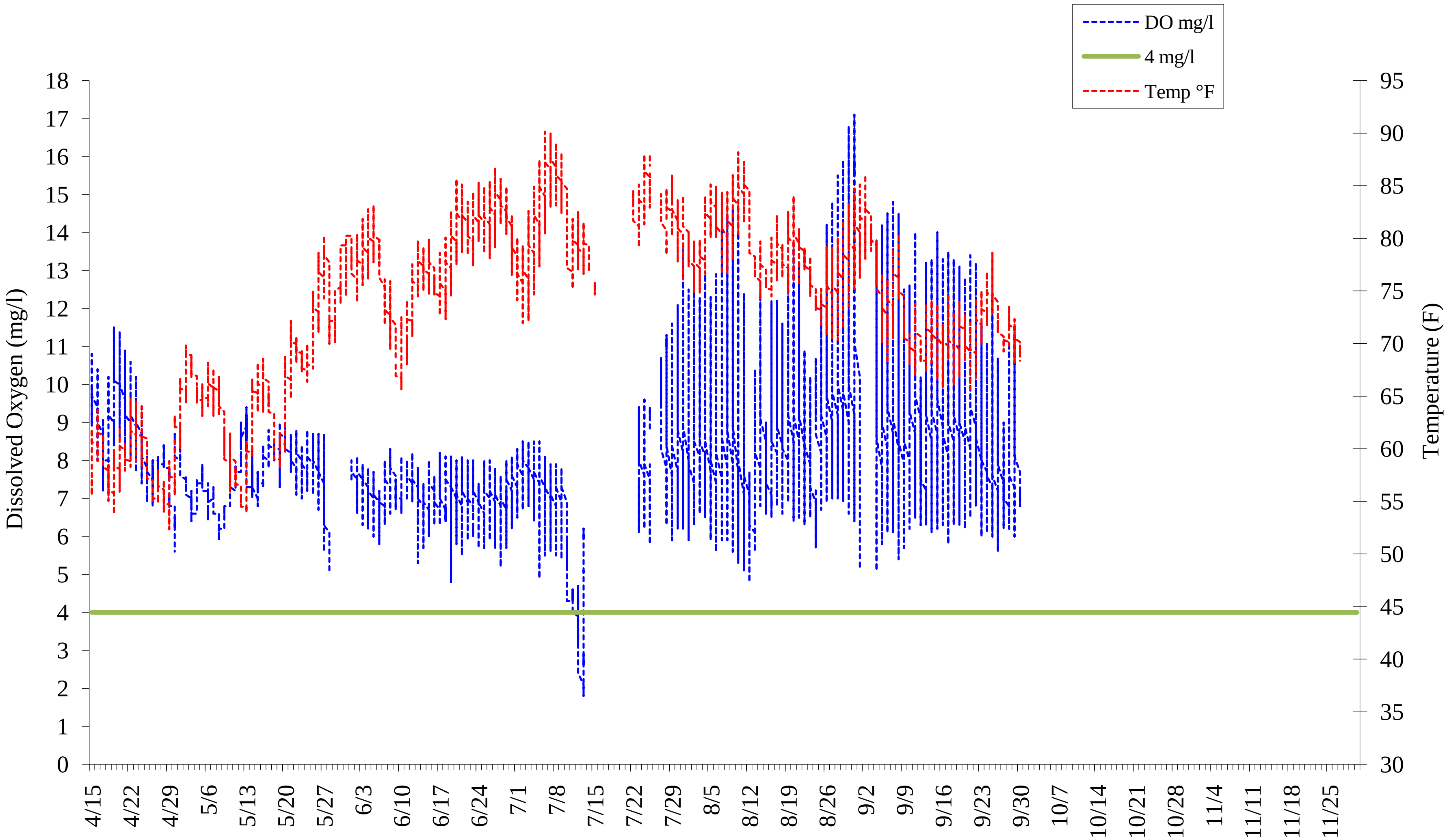


Figure 4.3-6. Hourly measurements of temperature and dissolved oxygen at Vincent Dam , April-September 2010.

Provisional data provided by the USGS when available
Data Collection discontinued by USGS October through March

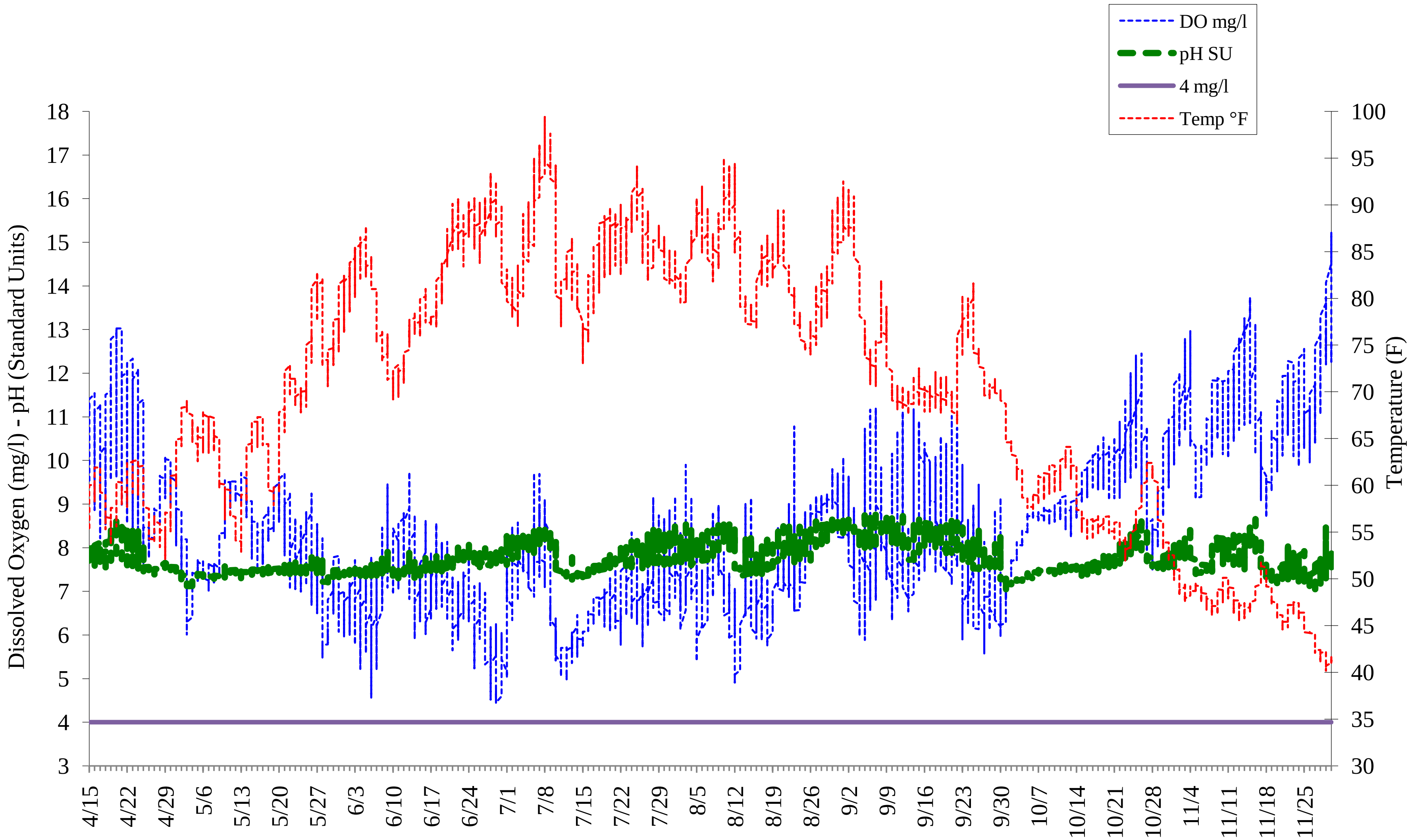


Figure 4.3-7. Hourly measurements of temperature, dissolved oxygen, and pH at Black Rock Dam, April-November 2010.

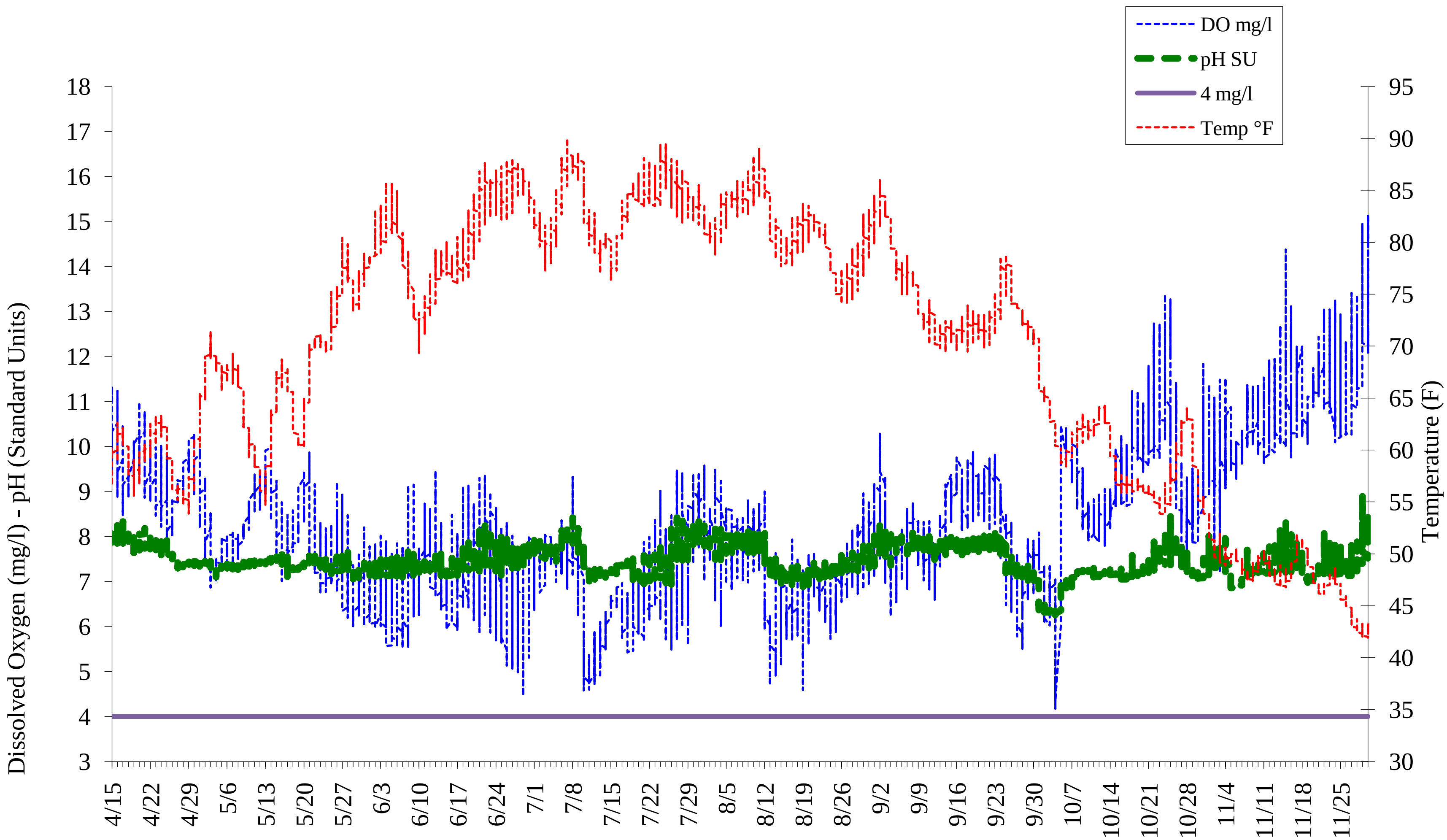


Figure 4.3-8. Hourly measurements of temperature, dissolved oxygen, and pH at Norristown Pool, April-November 2010.

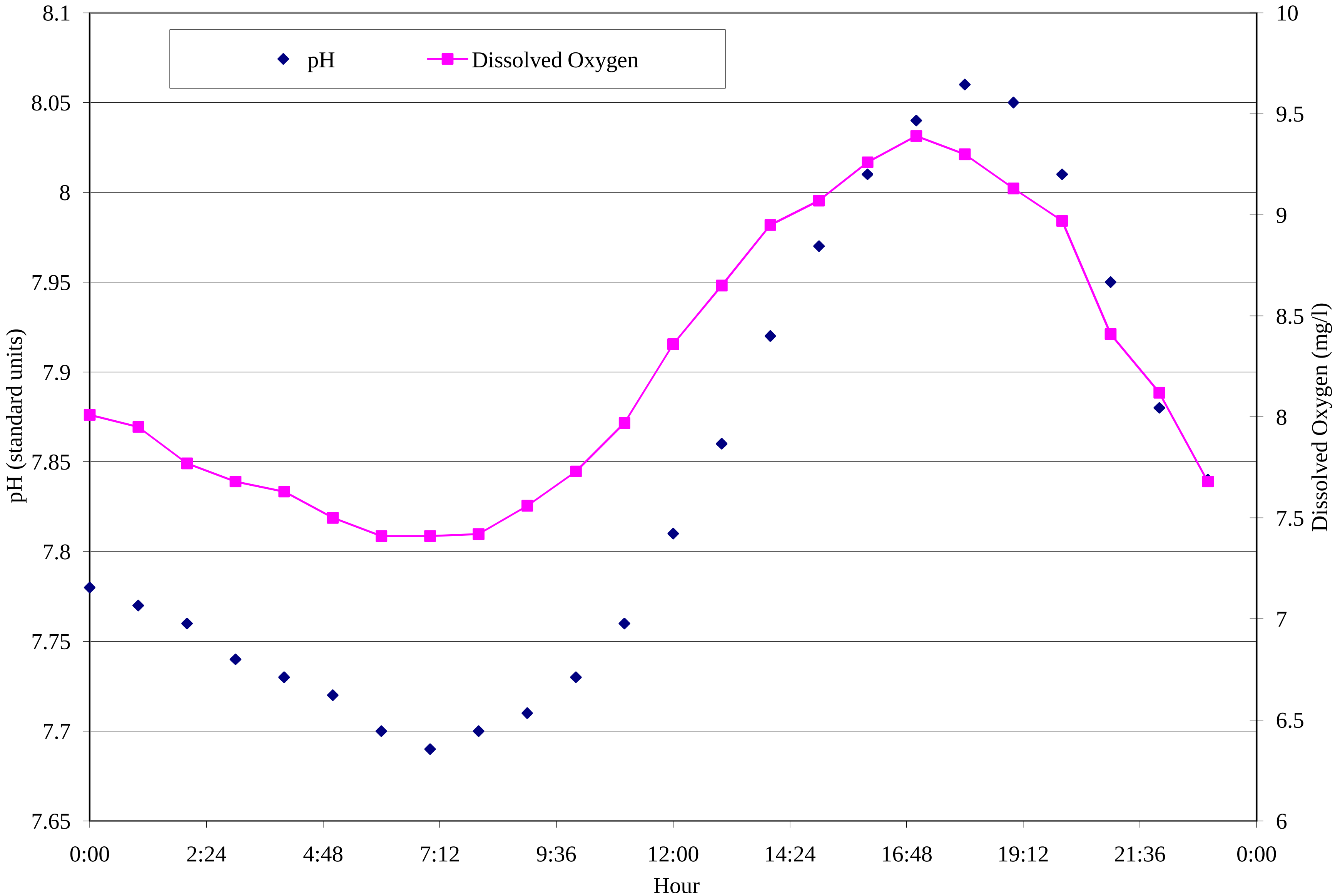


Figure 4.3-9. Example of diel fluctuation in pH and dissolved oxygen in the Schuylkill River.

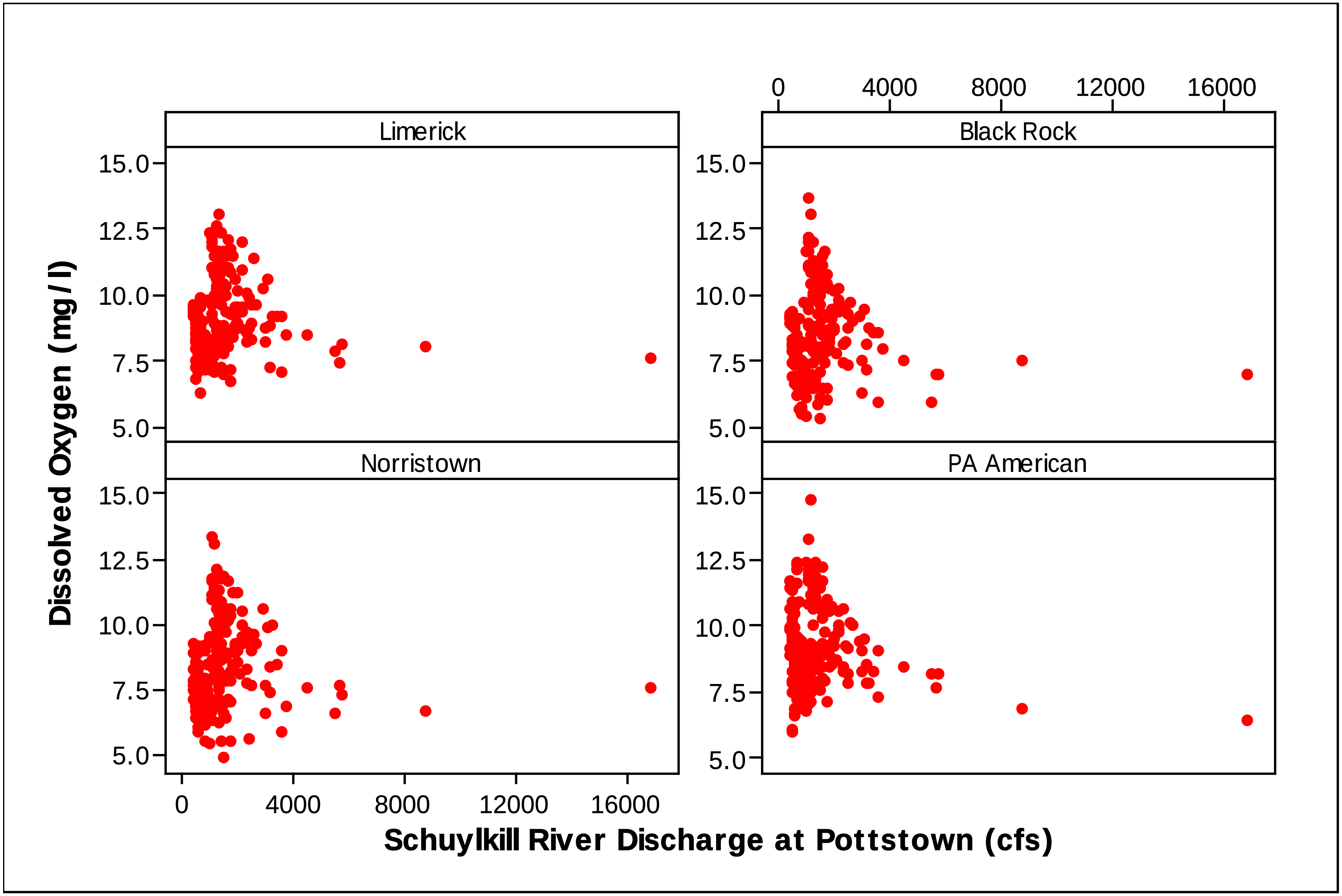


Figure 4.3-10. Relation of mean daily dissolved oxygen to Schuylkill River discharge at Pottstown for the Limerick Intake, Black Rock Dam, Pennsylvania American Intake, and Norristown Pool monitoring stations, April-November 2010.

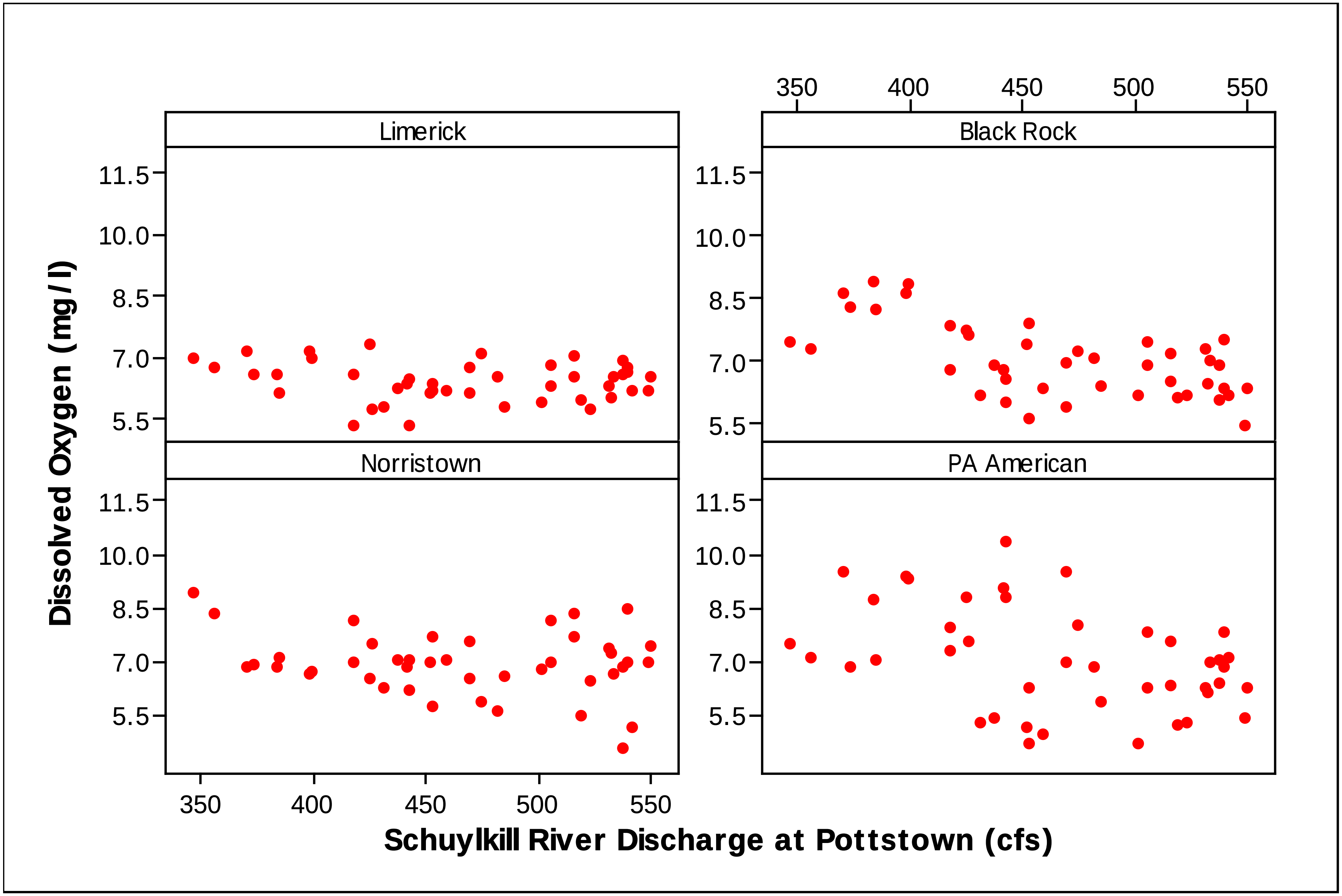


Figure 4.3-11. Relation of mean daily dissolved oxygen to Schuylkill River discharges at Pottstown less than 560 cfs for the Limerick Intake, Black Rock Dam, Pennsylvania American Intake, and Norristown Pool monitoring stations, April-November 2010.

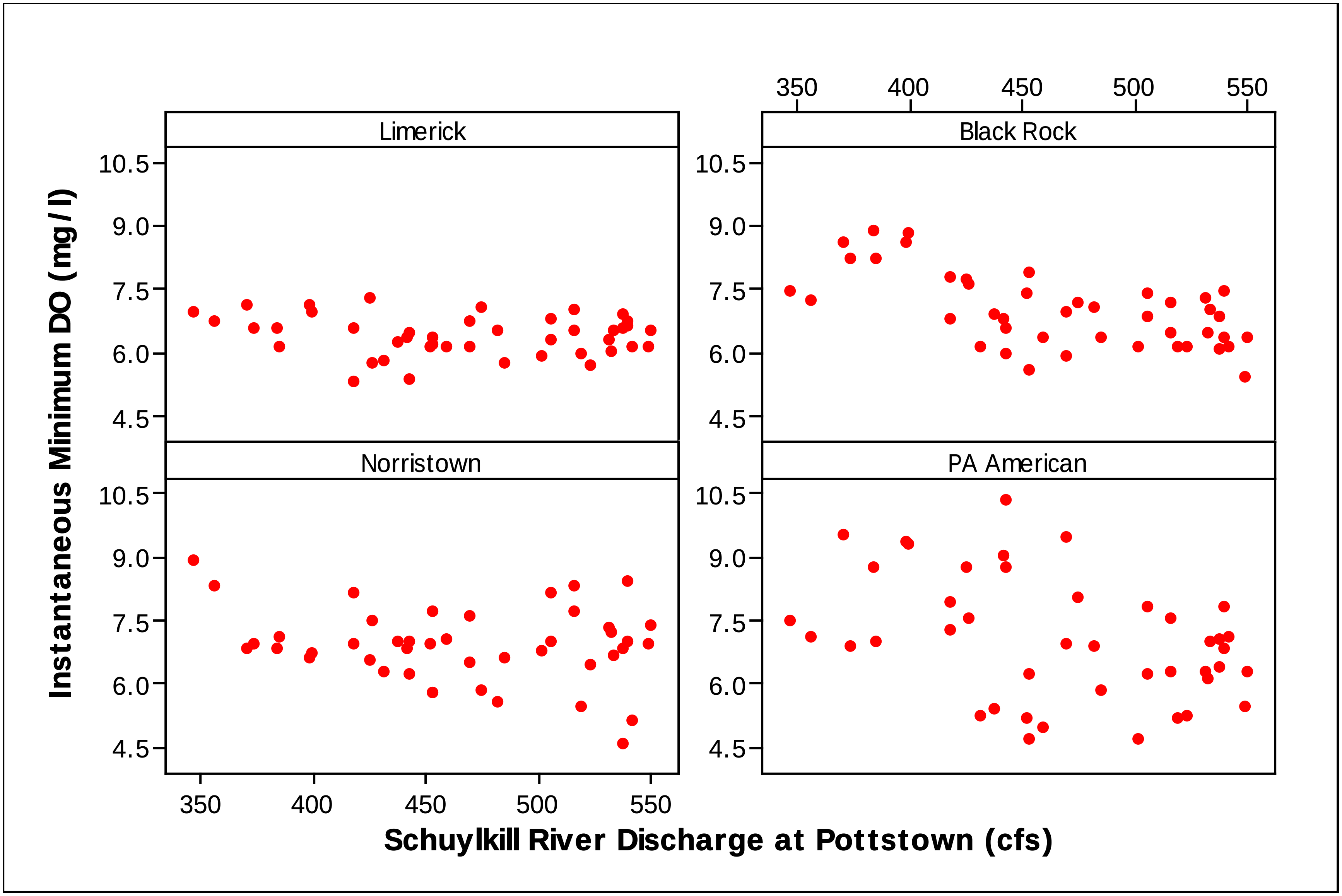


Figure 4.3-12. Relation of daily instantaneous minimum dissolved oxygen to Schuylkill River discharges at Pottstown less than 560 cfs for the Limerick Intake, Black Rock Dam, Pennsylvania American Intake, and Norristown Pool monitoring stations, April-November 2010.

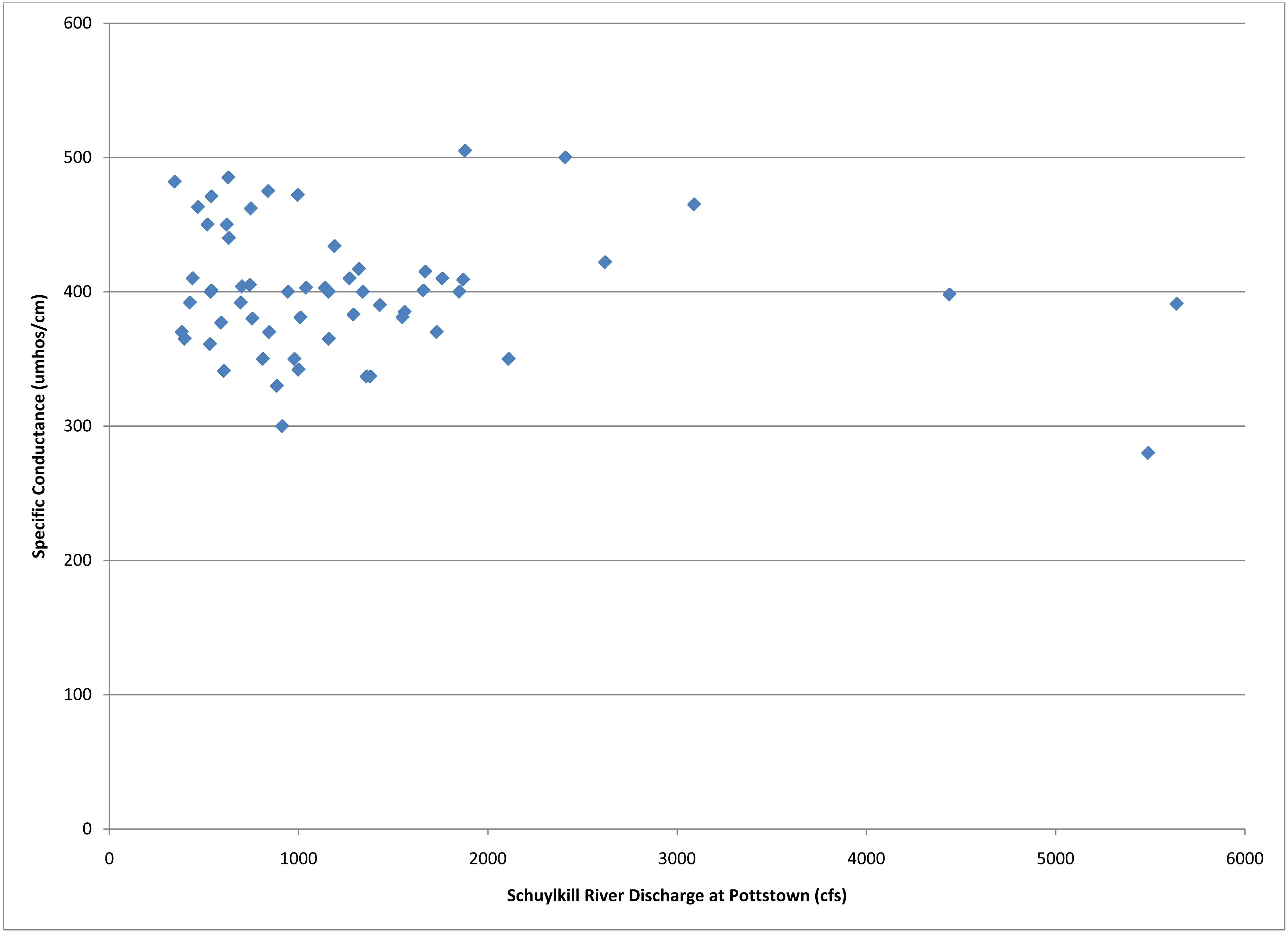


Figure 4.4-1. Relation of Schuylkill River discharge at Pottstown to specific conductance measured at the Pottstown Water Treatment Plant, April-November 2010.

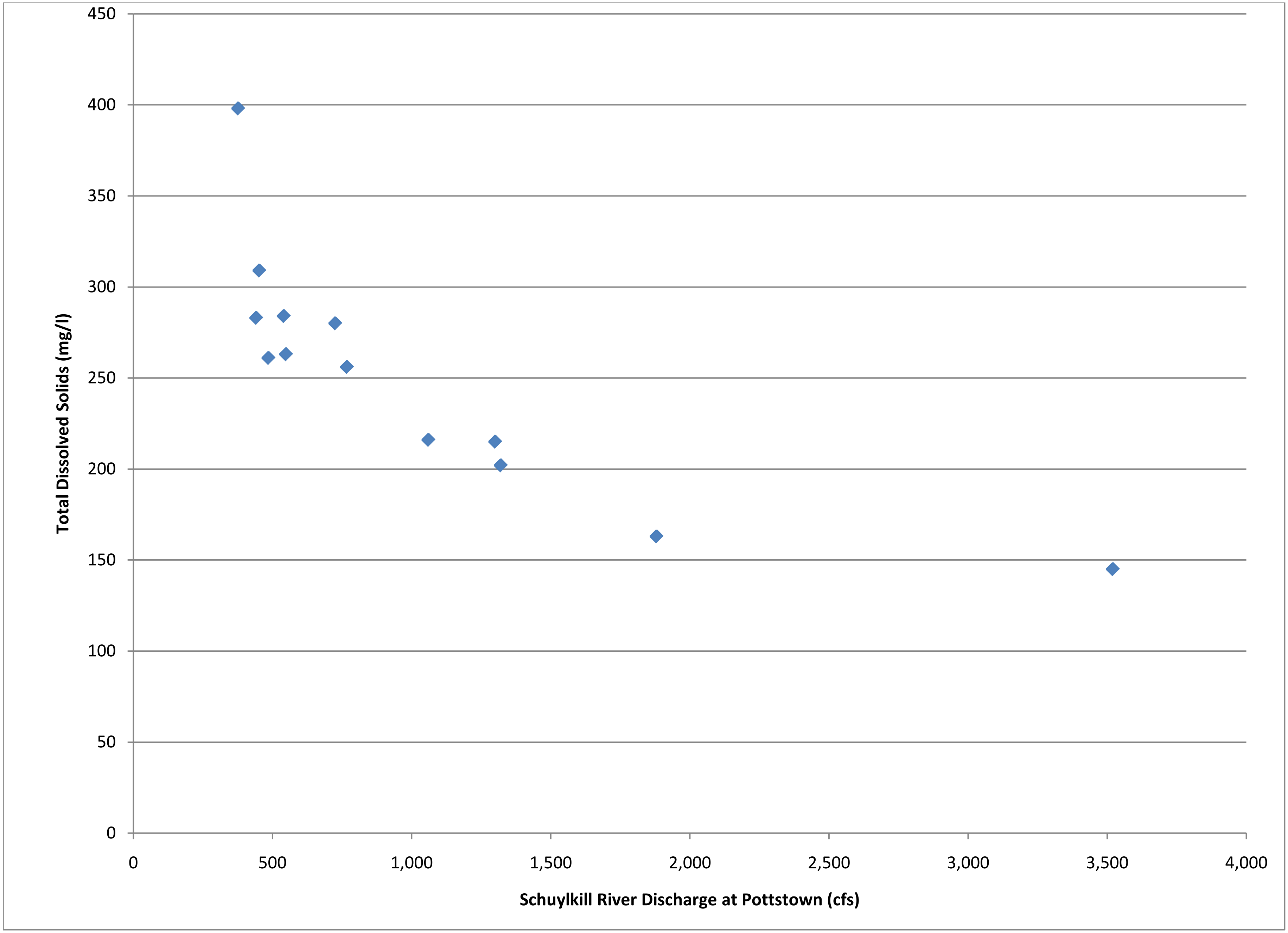


Figure 4.4-2. Relation of Schuylkill River discharge at Pottstown to the concentration of total dissolved solids measured at the Pennsylvania American Intake, April-November 2010.

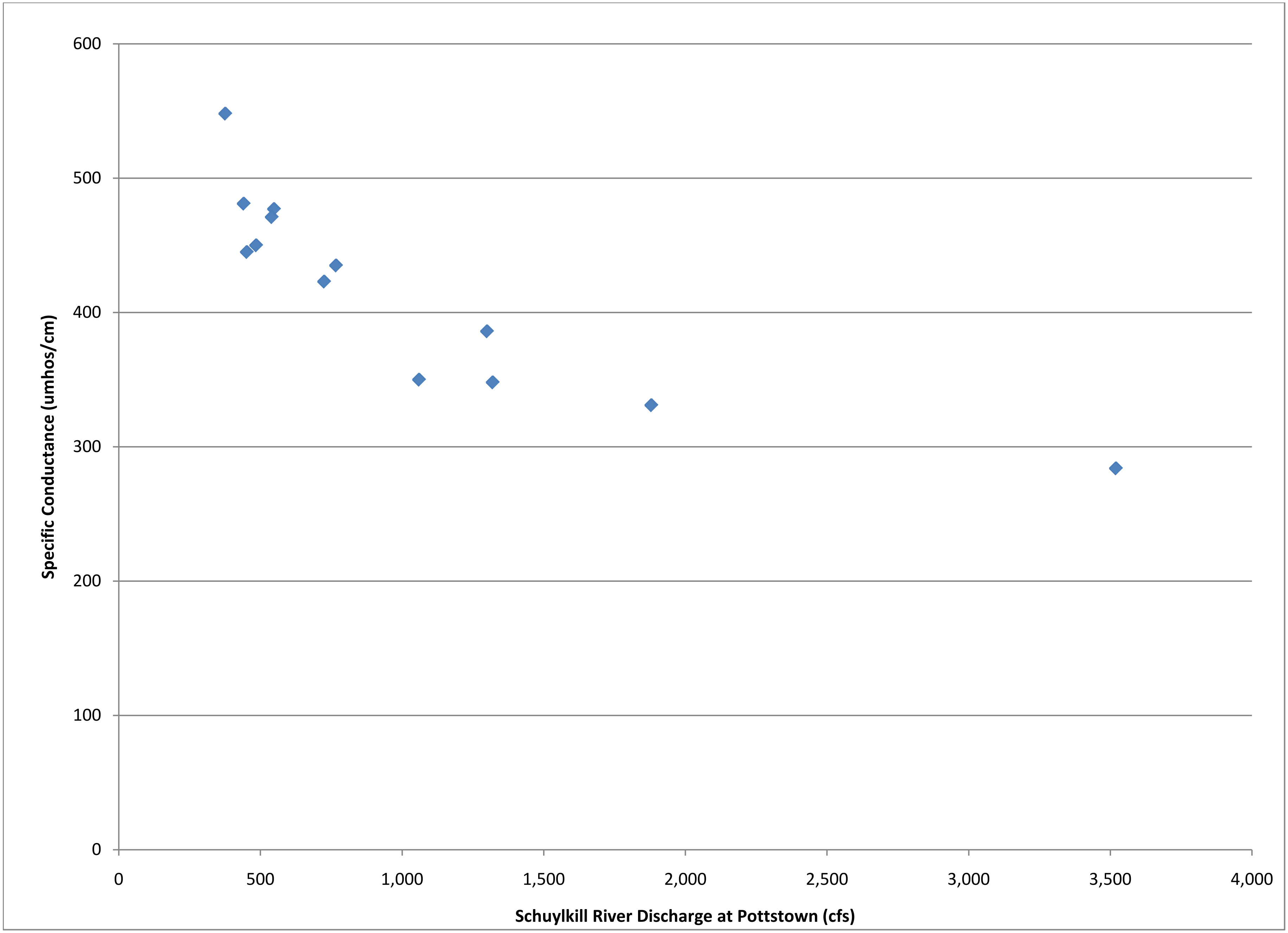


Figure 4.4-3. Relation of Schuylkill River discharge at Pottstown to specific conductance measured at the Pennsylvania American Intake, April-November 2010.

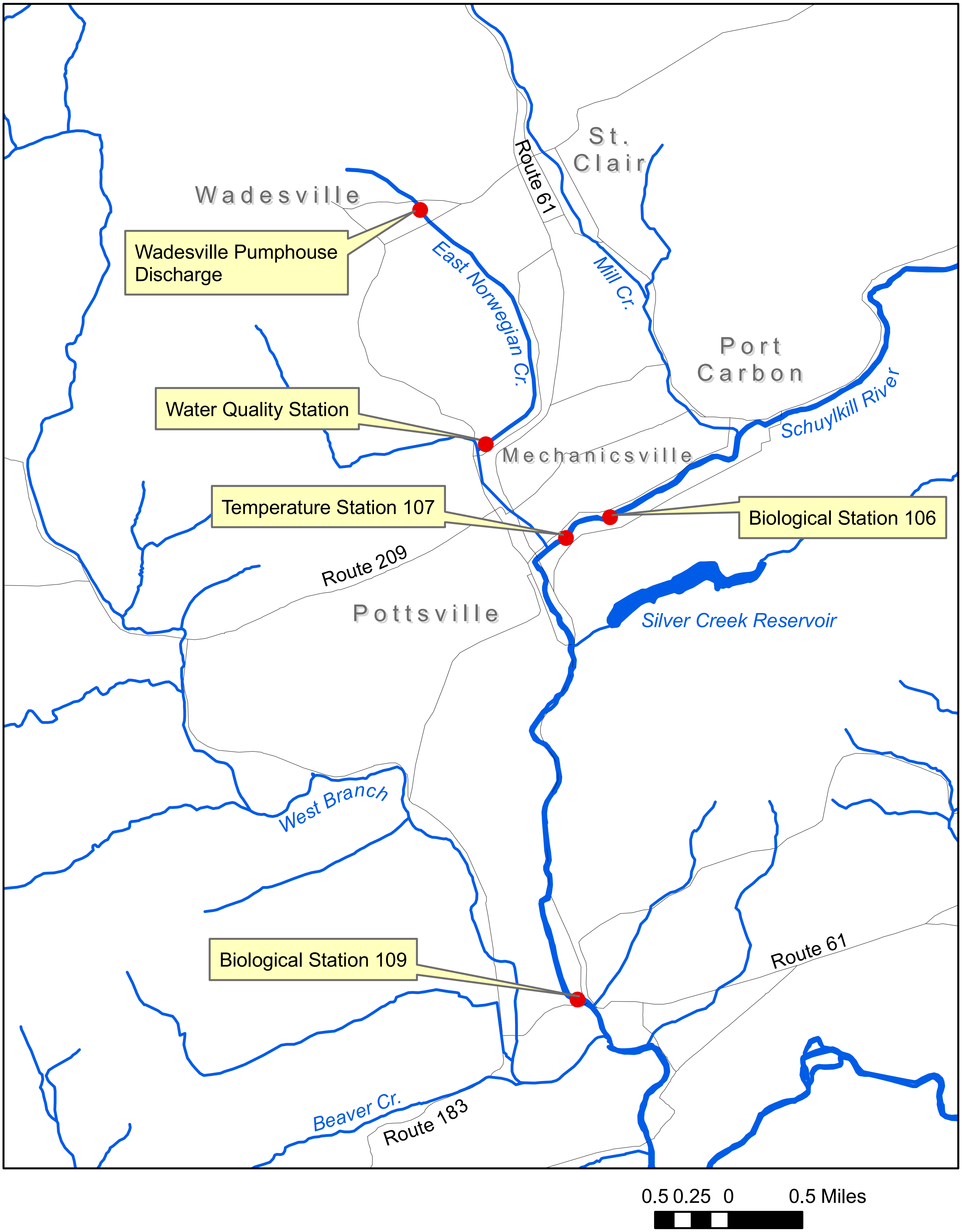


Figure 4.5-1.

Location of sampling stations near Pottsville.

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date: 12/19/07
project: 20340.002
prepared by: s.sherman

checked by: b.lees
file name: 20340_
Wadesville_Figure 4.5-1.mxd

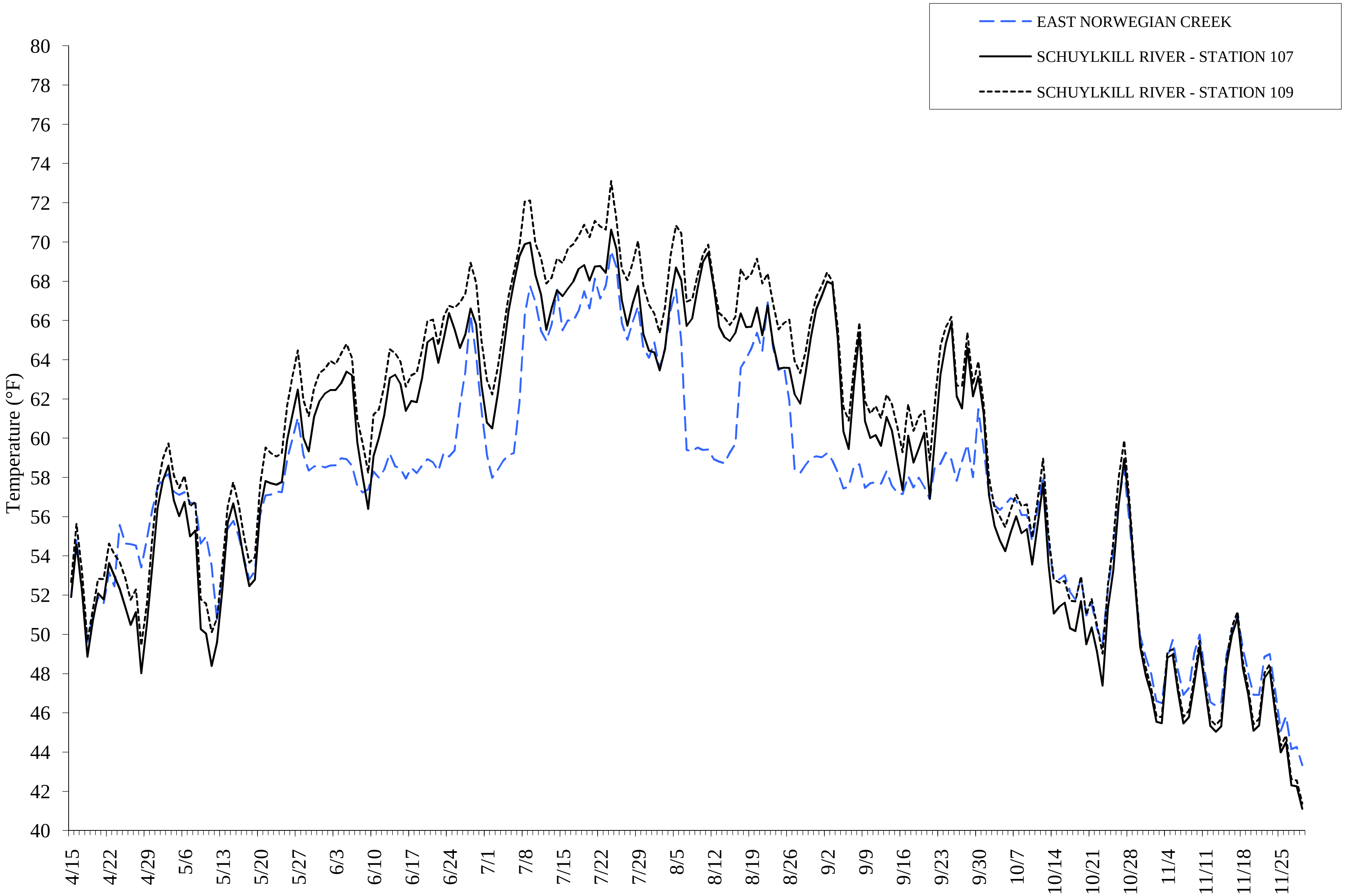
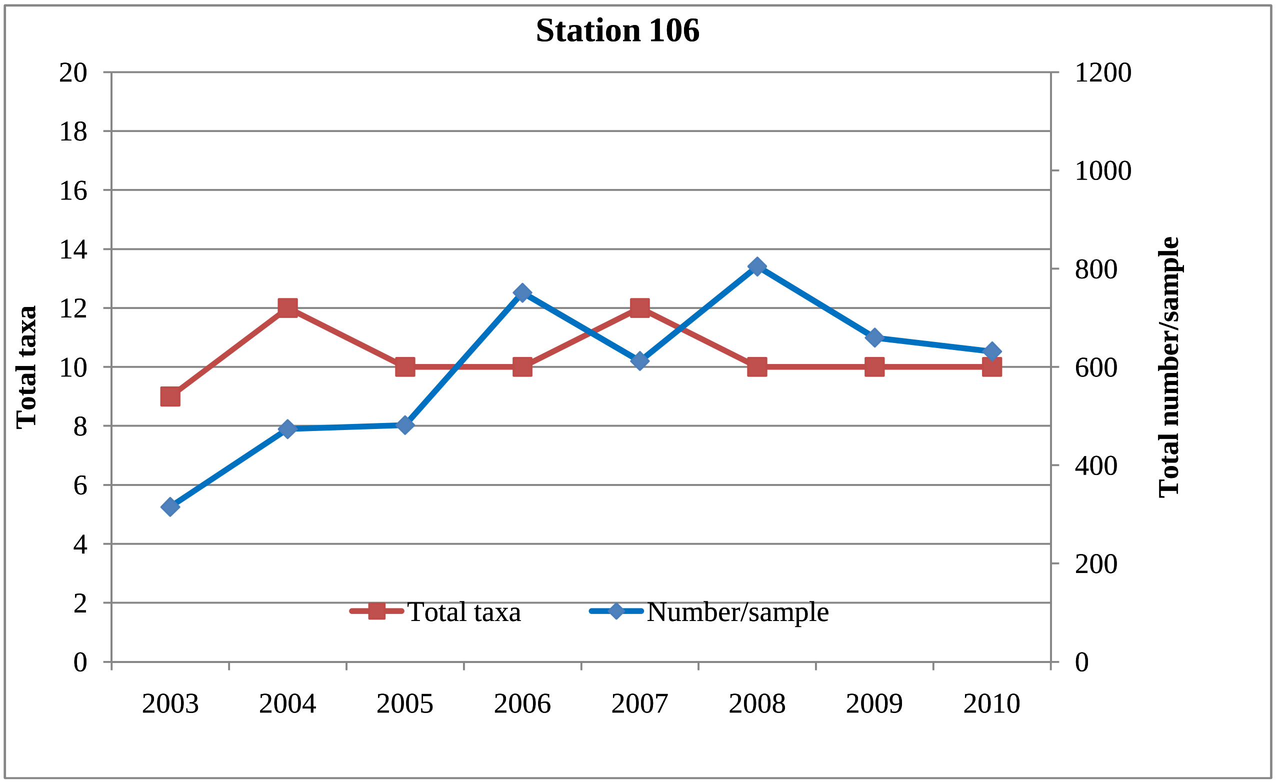


Figure 4.5-2. Relation of daily mean water temperature measured in East Norwegian Creek and at Stations 107 and 109 in the Schuylkill River, April-November 2010.



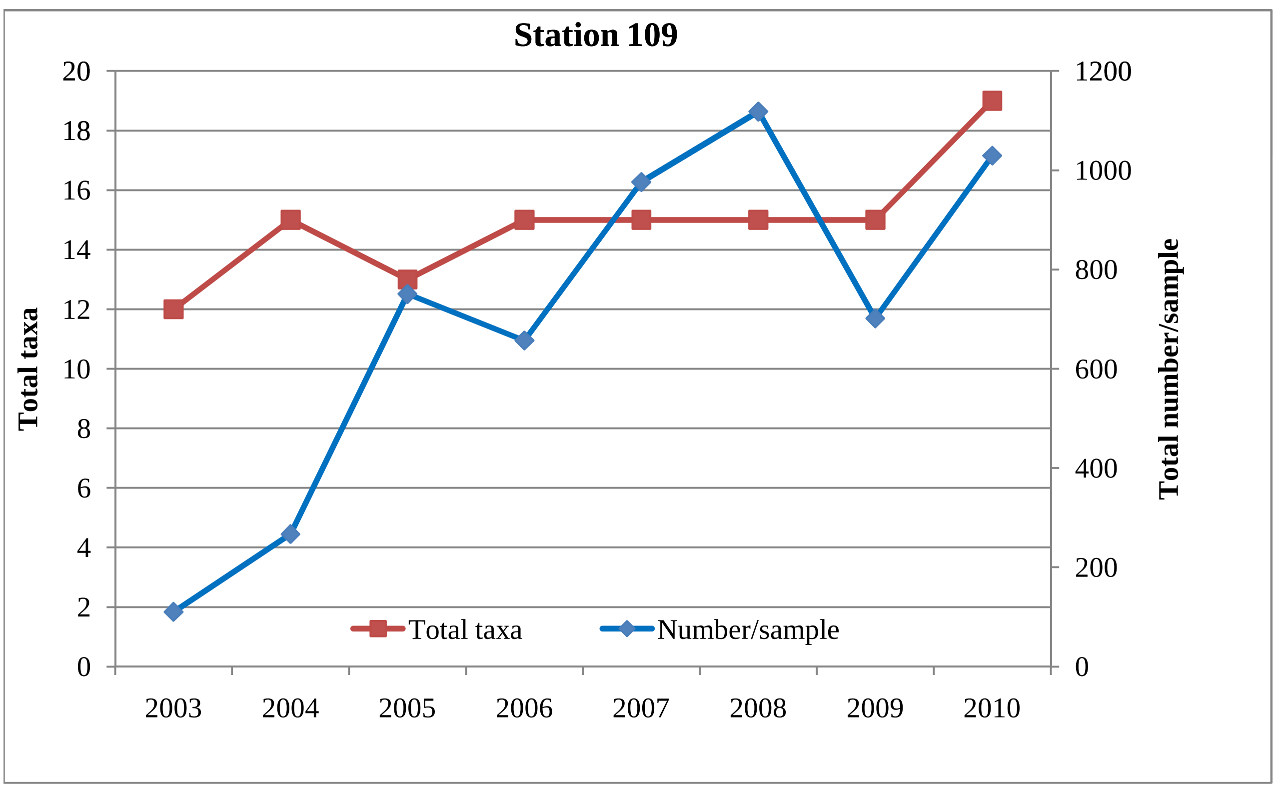
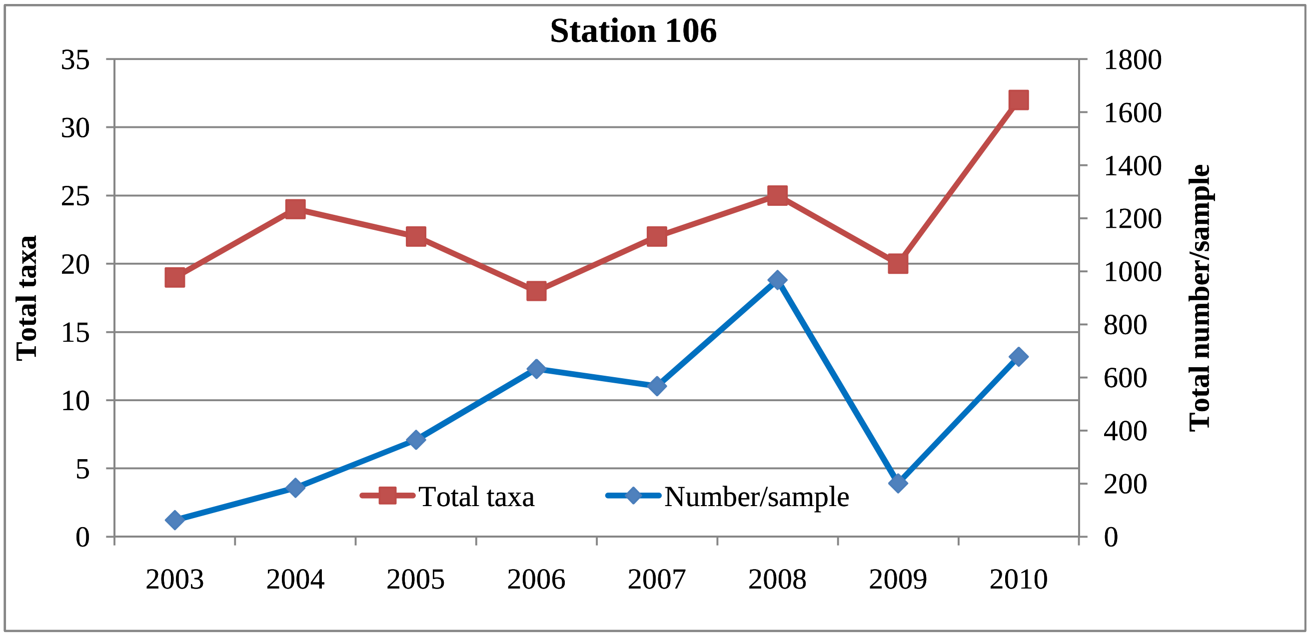


Figure 4.6-1. Total taxa and average number of fish collected per sampling event from Stations 106 and 109 in the Schuylkill River, 2003-2010.



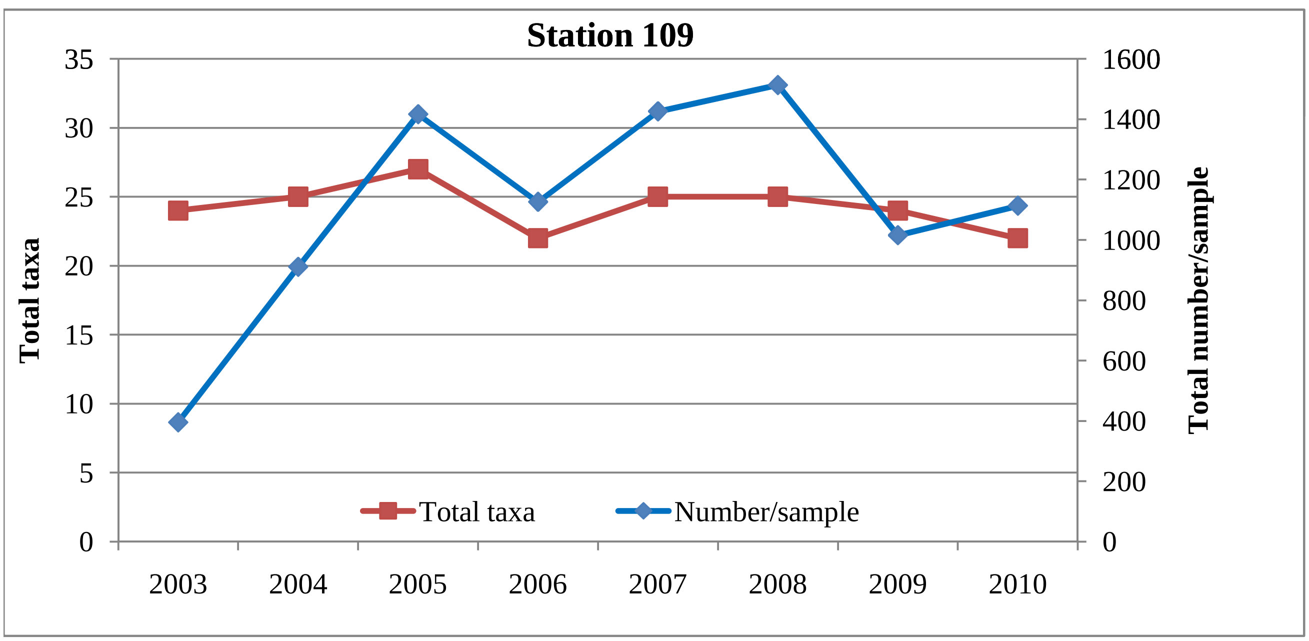
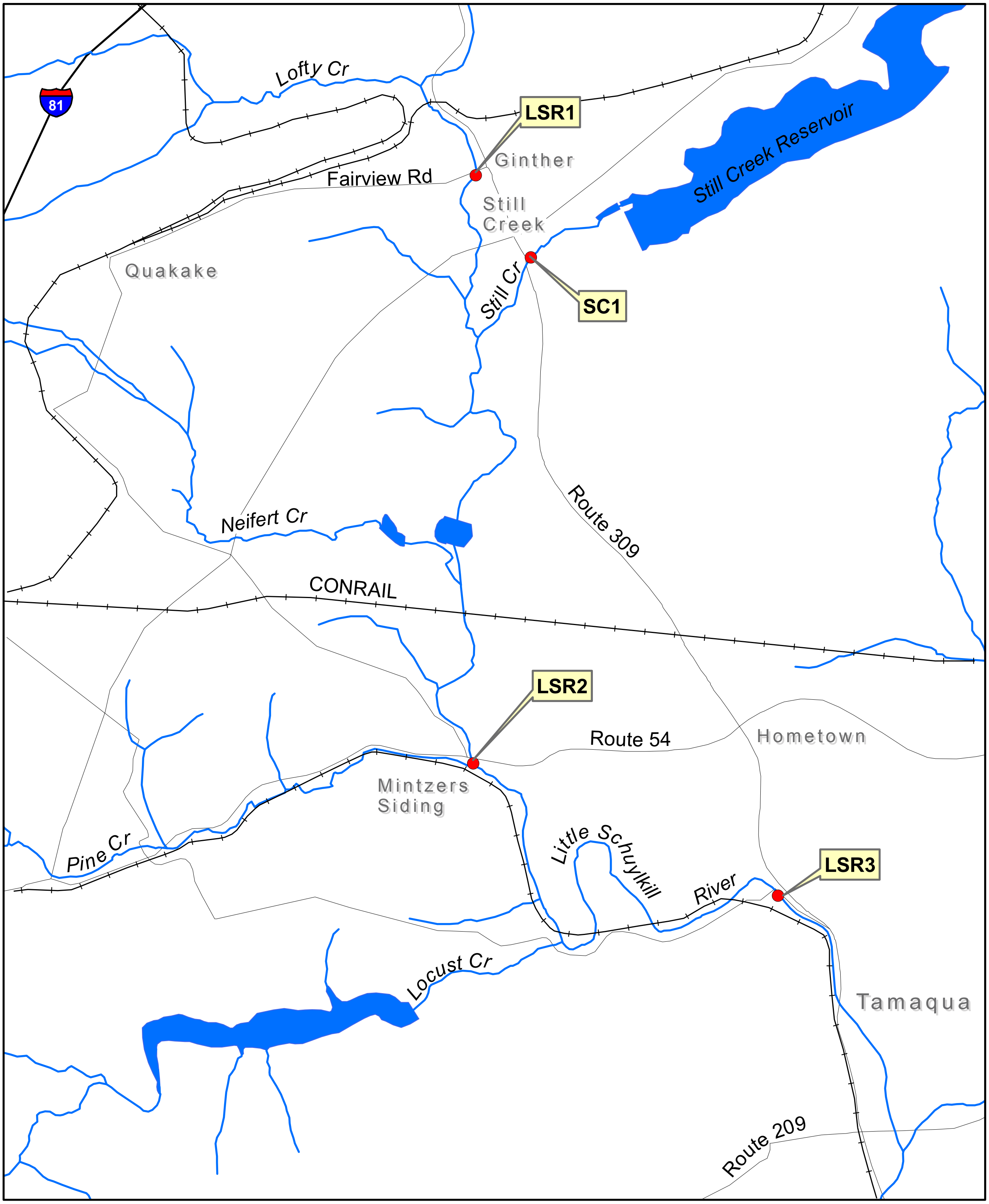


Figure 4.6-2. Total taxa and average number of benthic macroinvertebrates collected per sampling event from Stations 106 and 109 in the Schuylkill River, 2003-2010.



LSR1, LSR2, SC1: Flow, Temperature, Water Quality
LSR3: Temperature

0.5 0.25 0 0.5 Miles

Figure 4.8-1

Water quality monitoring sites within the Little Schuylkill River watershed.

N

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checked by: b.lees
file name: 20340_
Wadesville_Figure 4.8-1.mxd

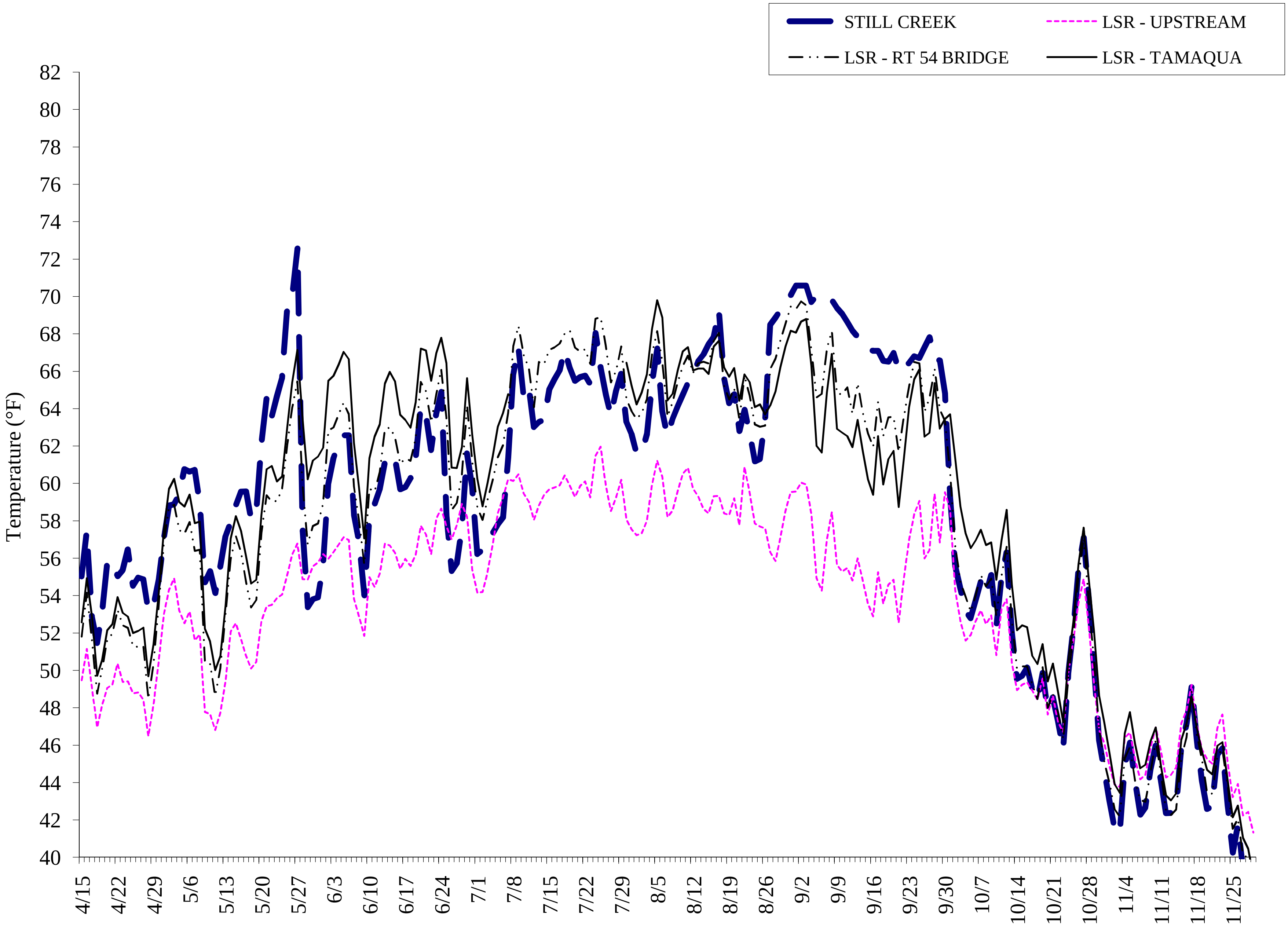

Figure 4.8-2. Mean daily water temperature measured in Still Creek, Little Schuylkill River (LSR) upstream of Still Creek, LSR downstream of Still Creek, and LSR near Tamaqua, April-November 2010.

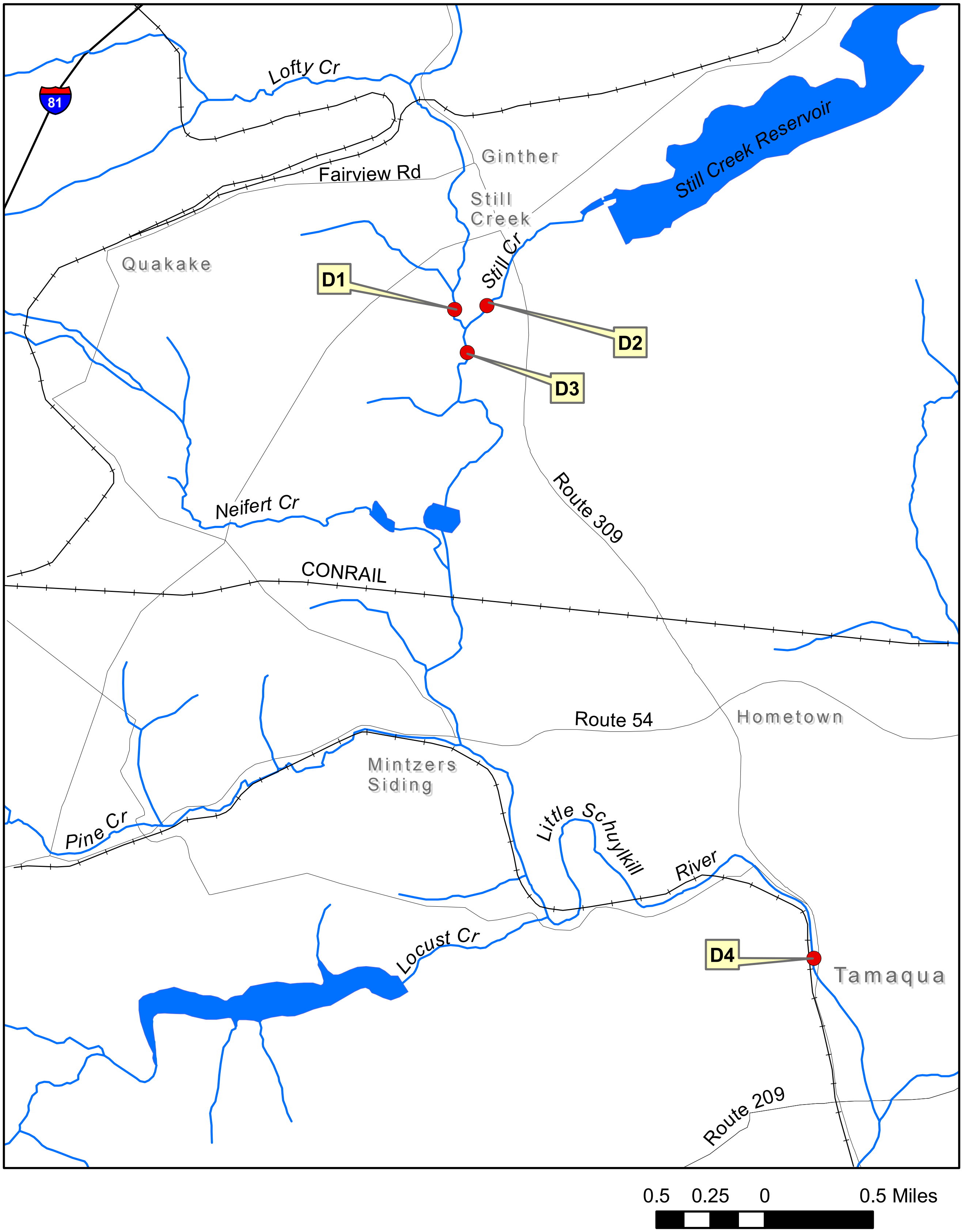

Figure 4.8-3

Locations of stream discharge monitoring within the Little Schuylkill River watershed.

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project: 20342.002

rev. date: 01/27/11
prepared fro: b.lees
filename: 20340_Wadesville_Figure 4.8-3

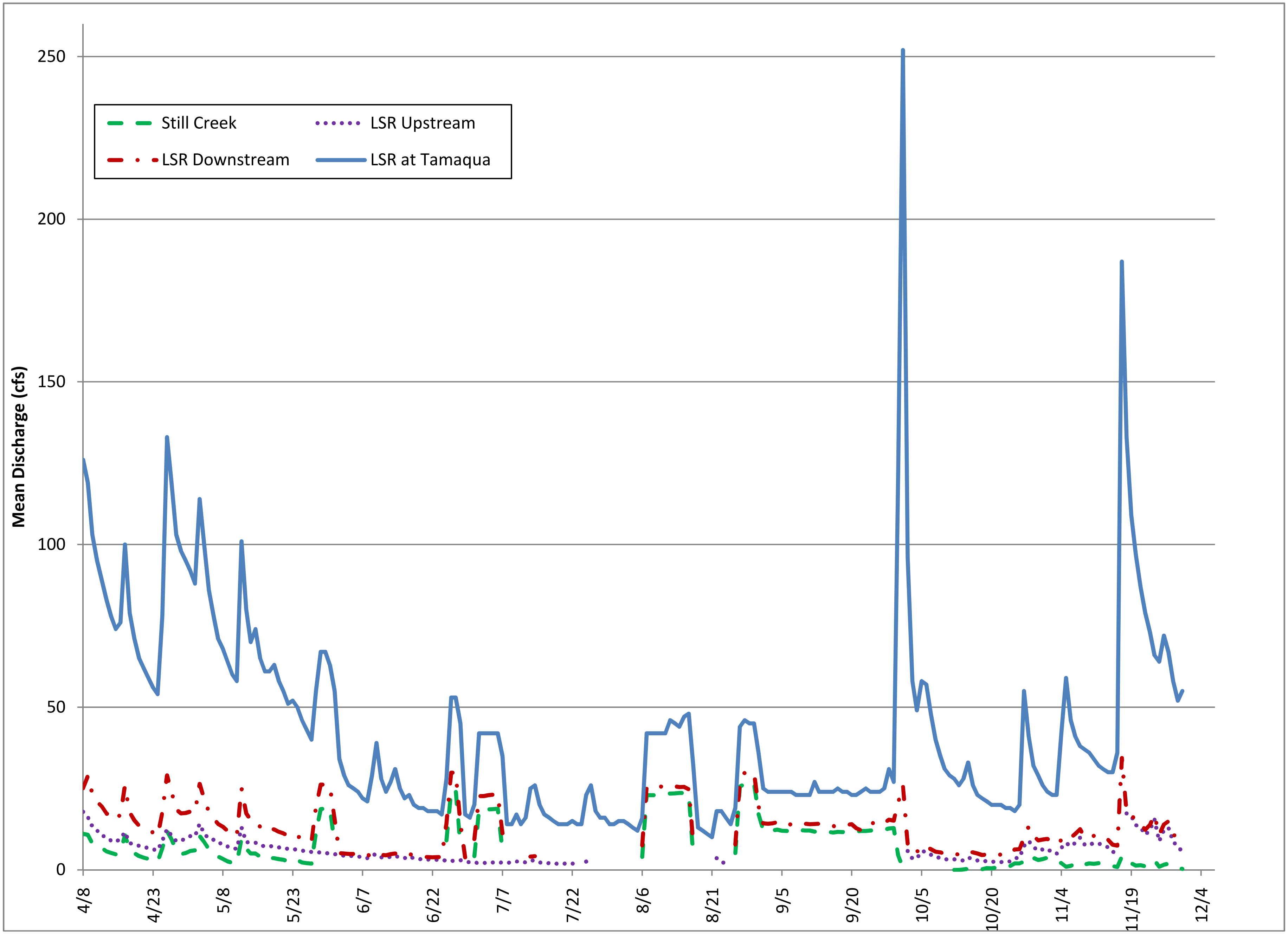

Figure 4.8-4. Little Schuylkill River (LSR) discharge at USGS Tamaqua gage, LSR discharge downstream of Still Creek, LSR discharge upstream of Still Creek, and Still Creek discharge, April-November 2010.

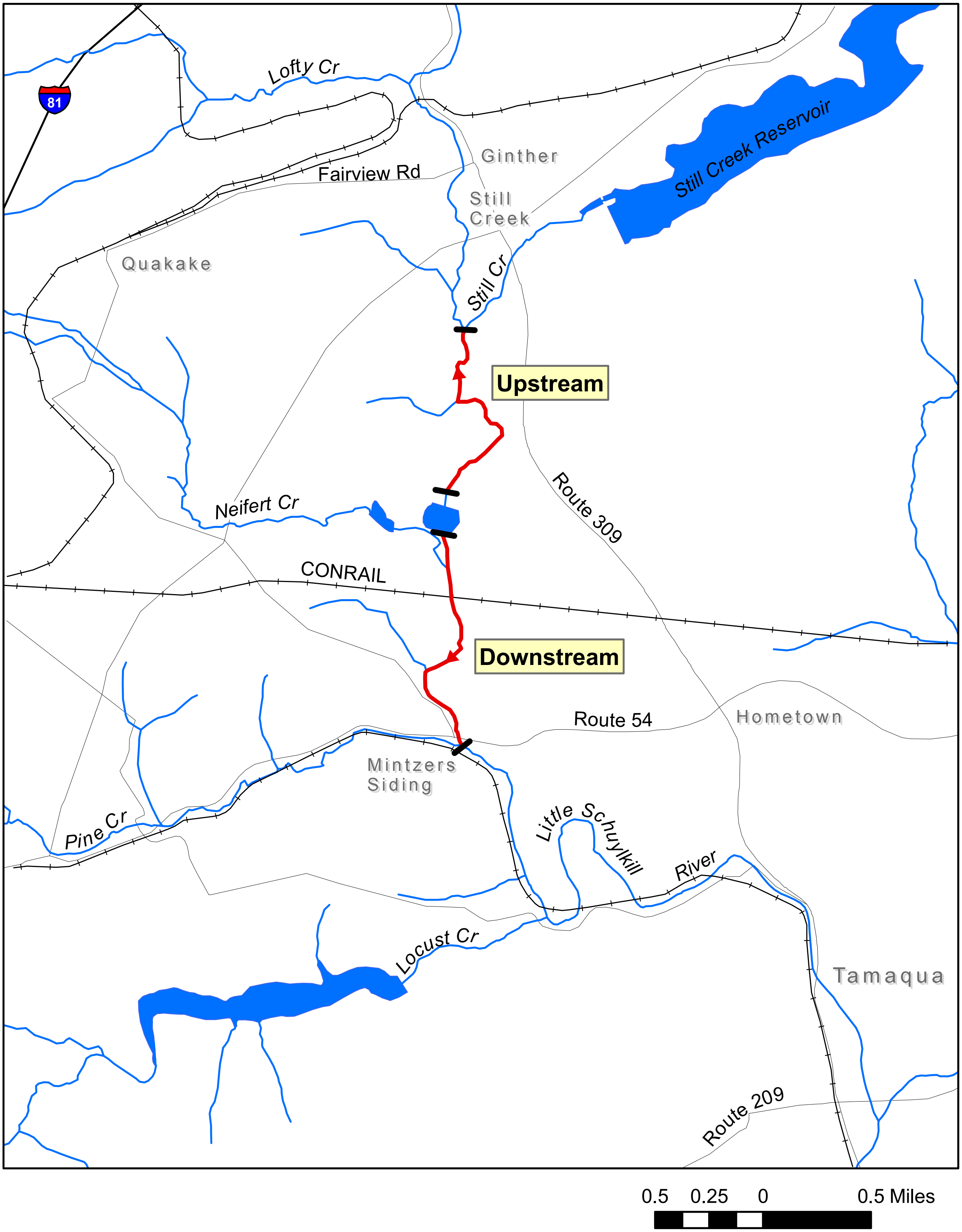

Figure 4.9-1.

Location of fish sampling stations in the Little Schuylkill River

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project: 20340.002
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checked by: b.lees
file name: 20340_
Wadesville Figure 4.9-1.mxd

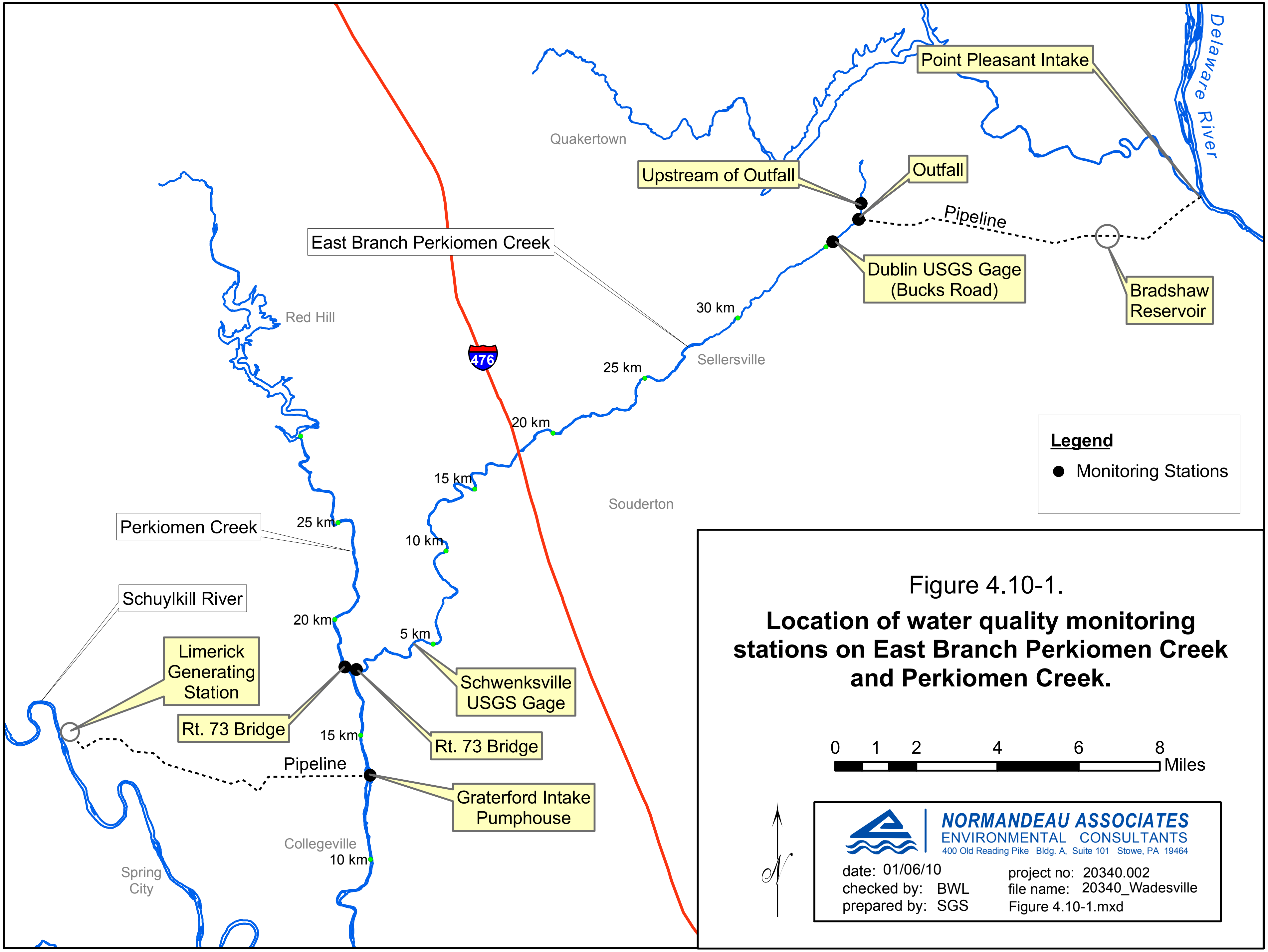

Figure 4.10-1.

Location of water quality monitoring stations on East Branch Perkiomen Creek and Perkiomen Creek.

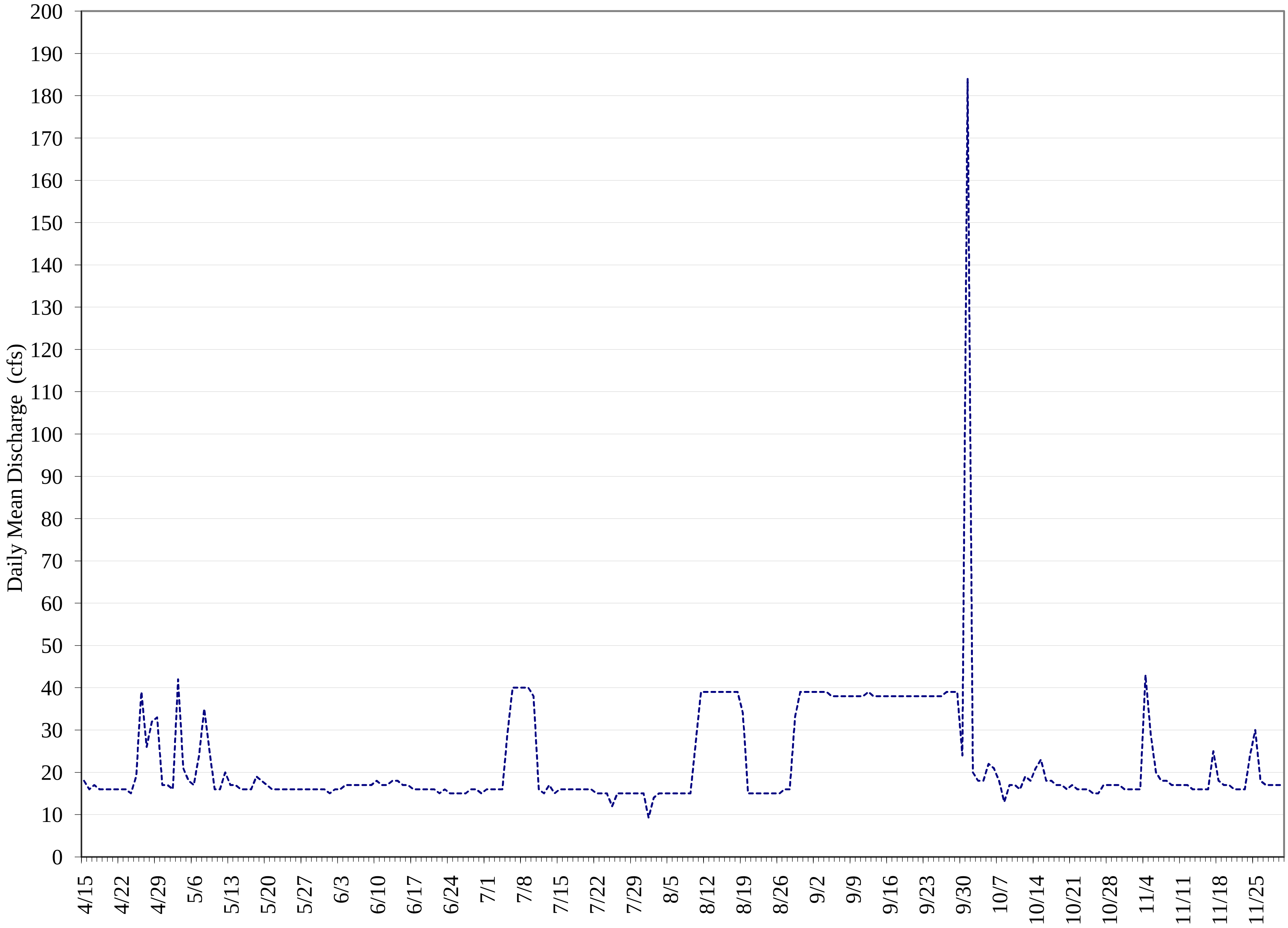

Figure 4.12-1. Daily discharge of the East Branch Perkiomen Creek at Bucks Road USGS gage, April-November 2010.

Provisional data subject to revision

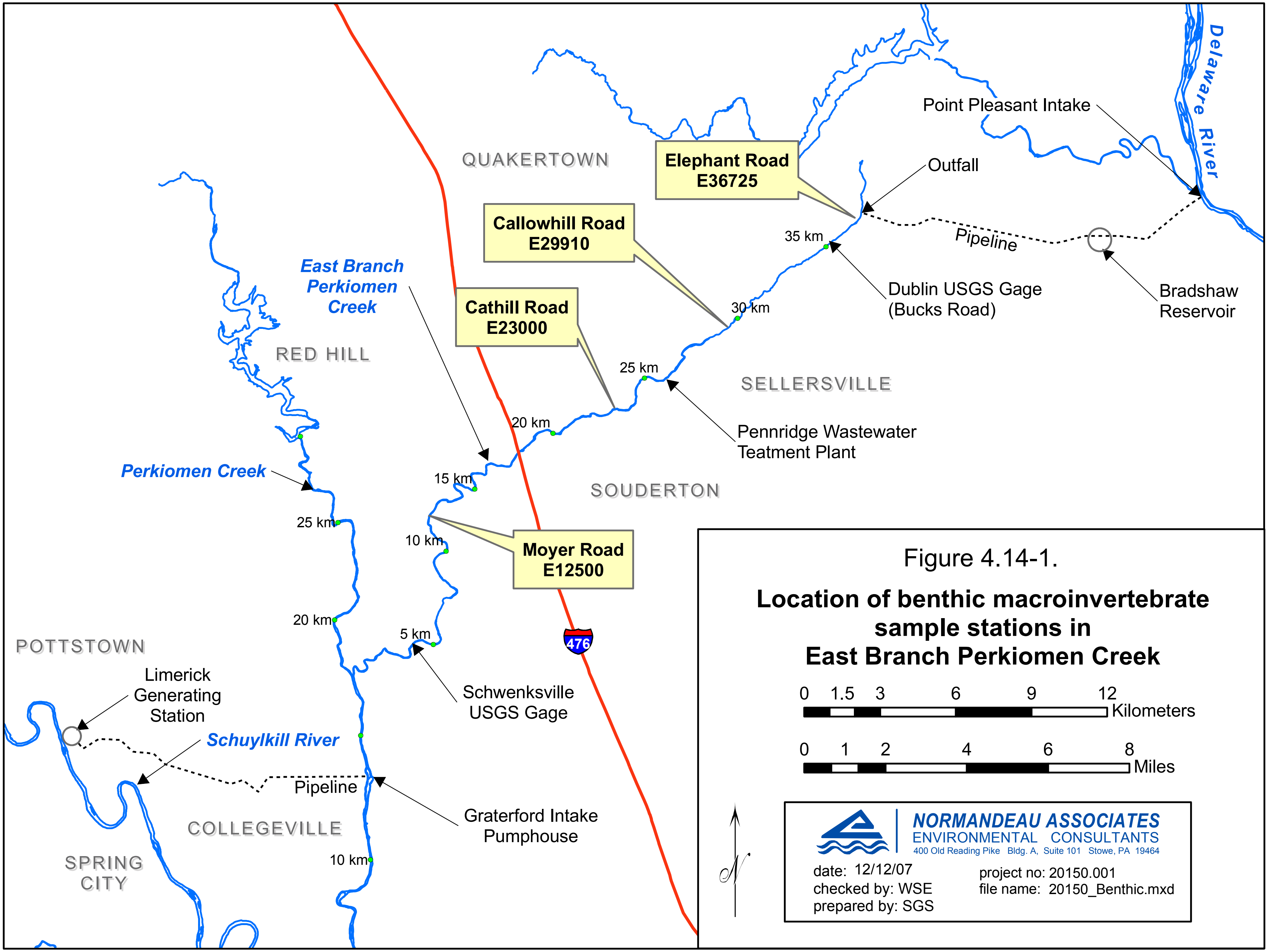

Figure 4.14-1.

Location of benthic macroinvertebrate sample stations in East Branch Perkiomen Creek

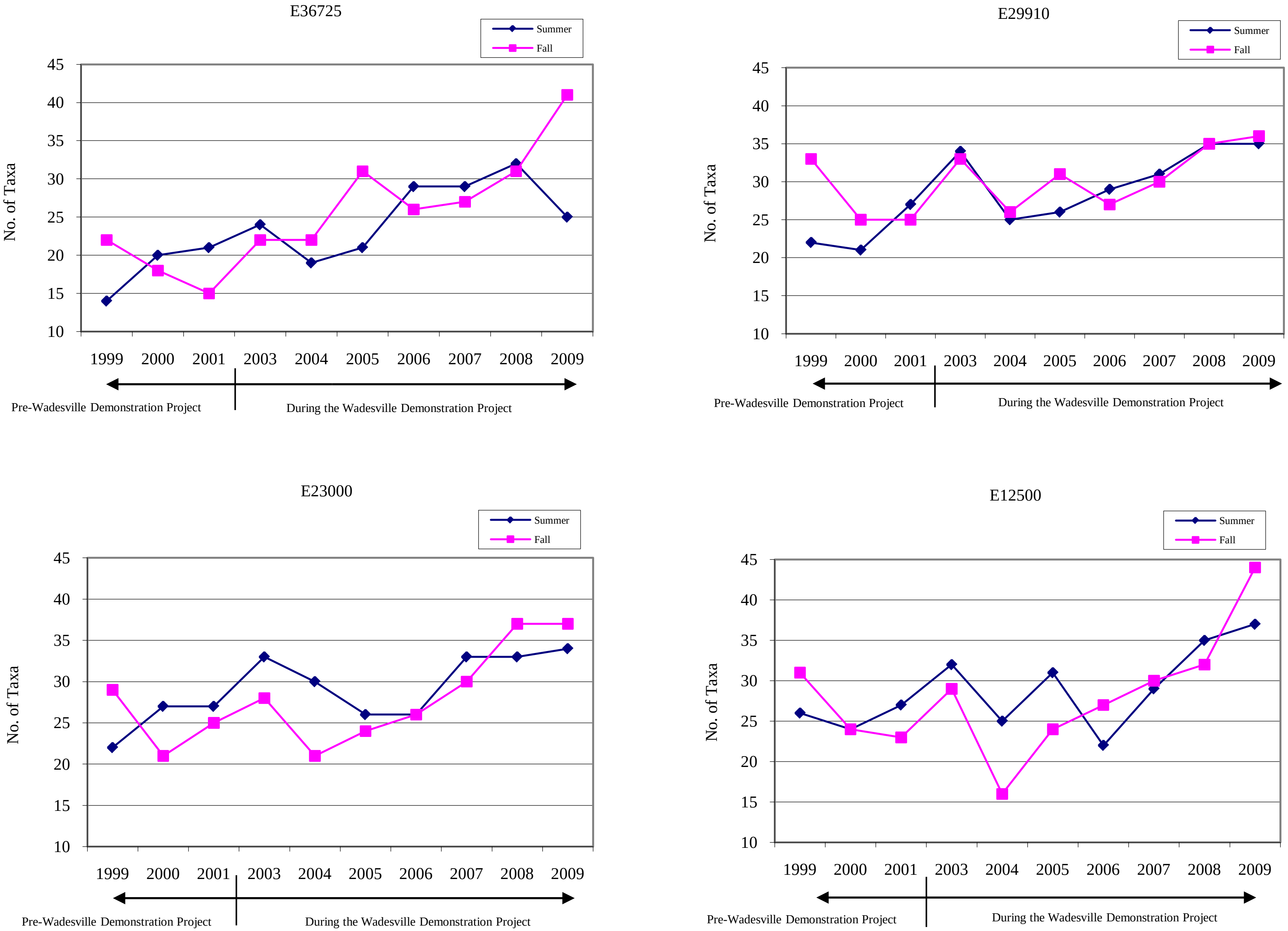

Figure 4.14-2. Total number of macroinvertebrate taxa collected at the four East Branch Perkiomen Creek stations, 1999-2009.

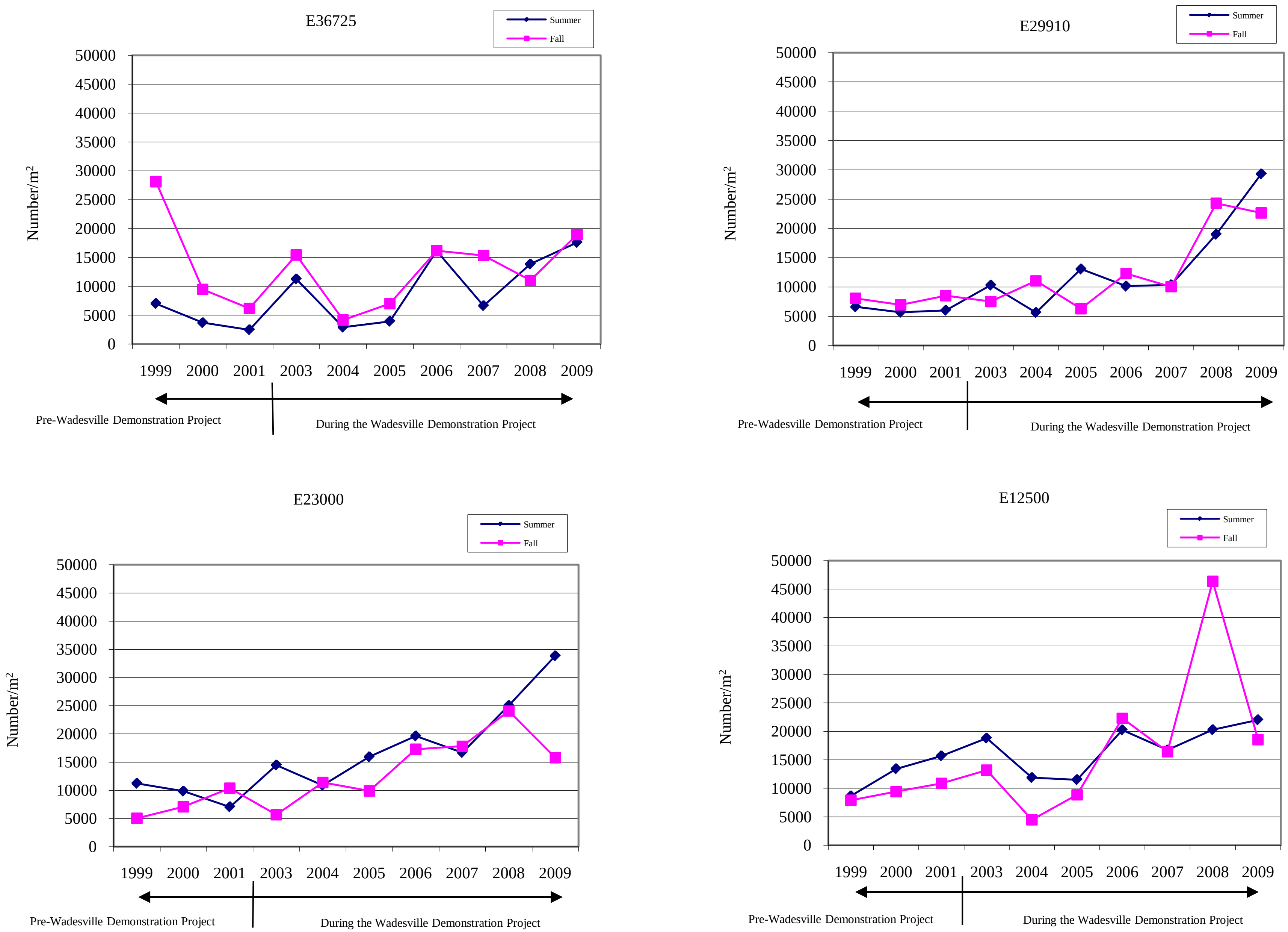

Figure 4.14-3. Mean density of macroinvertebrates collected at the four East Branch Perkiomen Creek stations, 1999-2009.

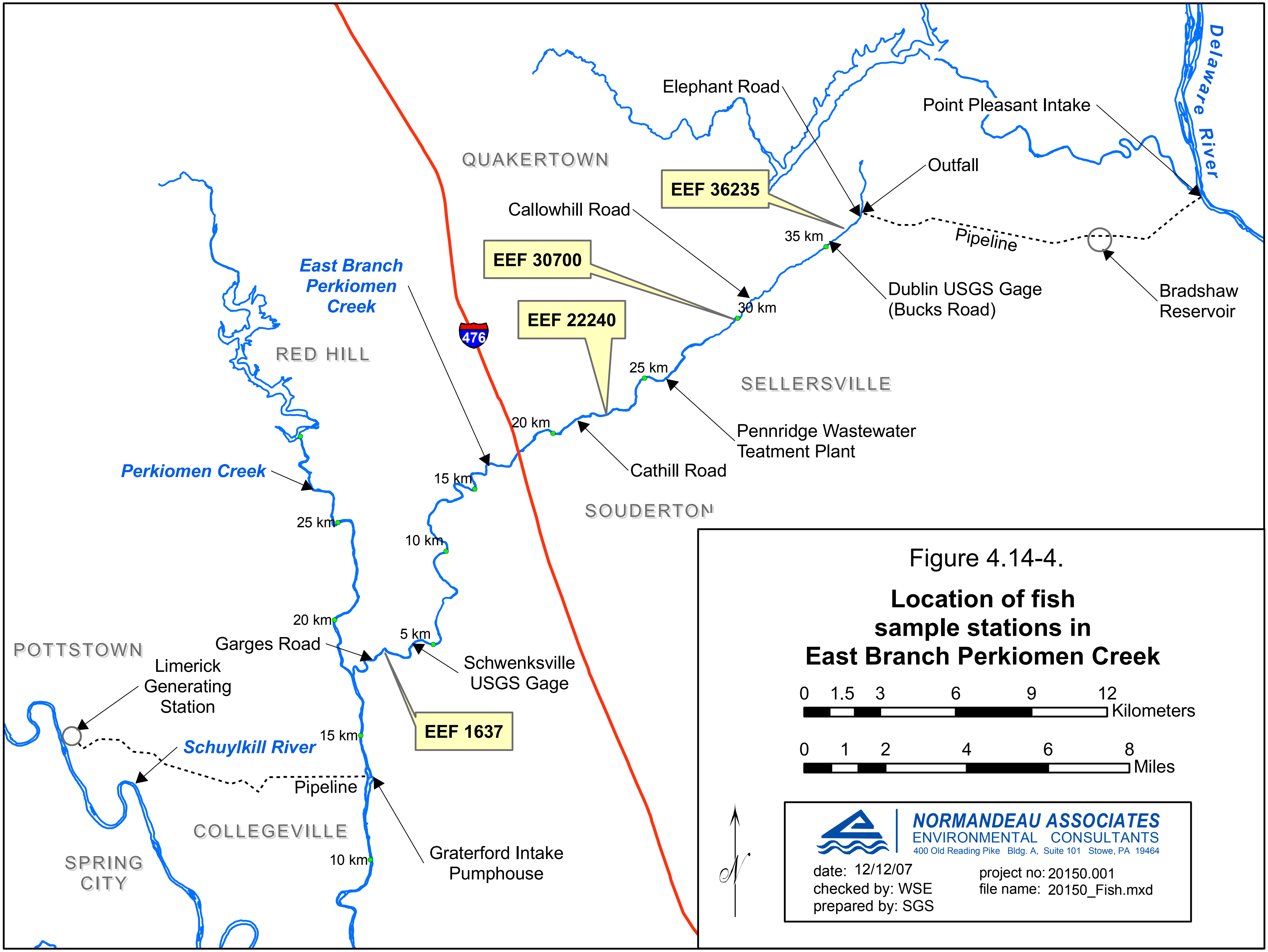

Figure 4.14-4.

Location of fish sample stations in East Branch Perkiomen Creek

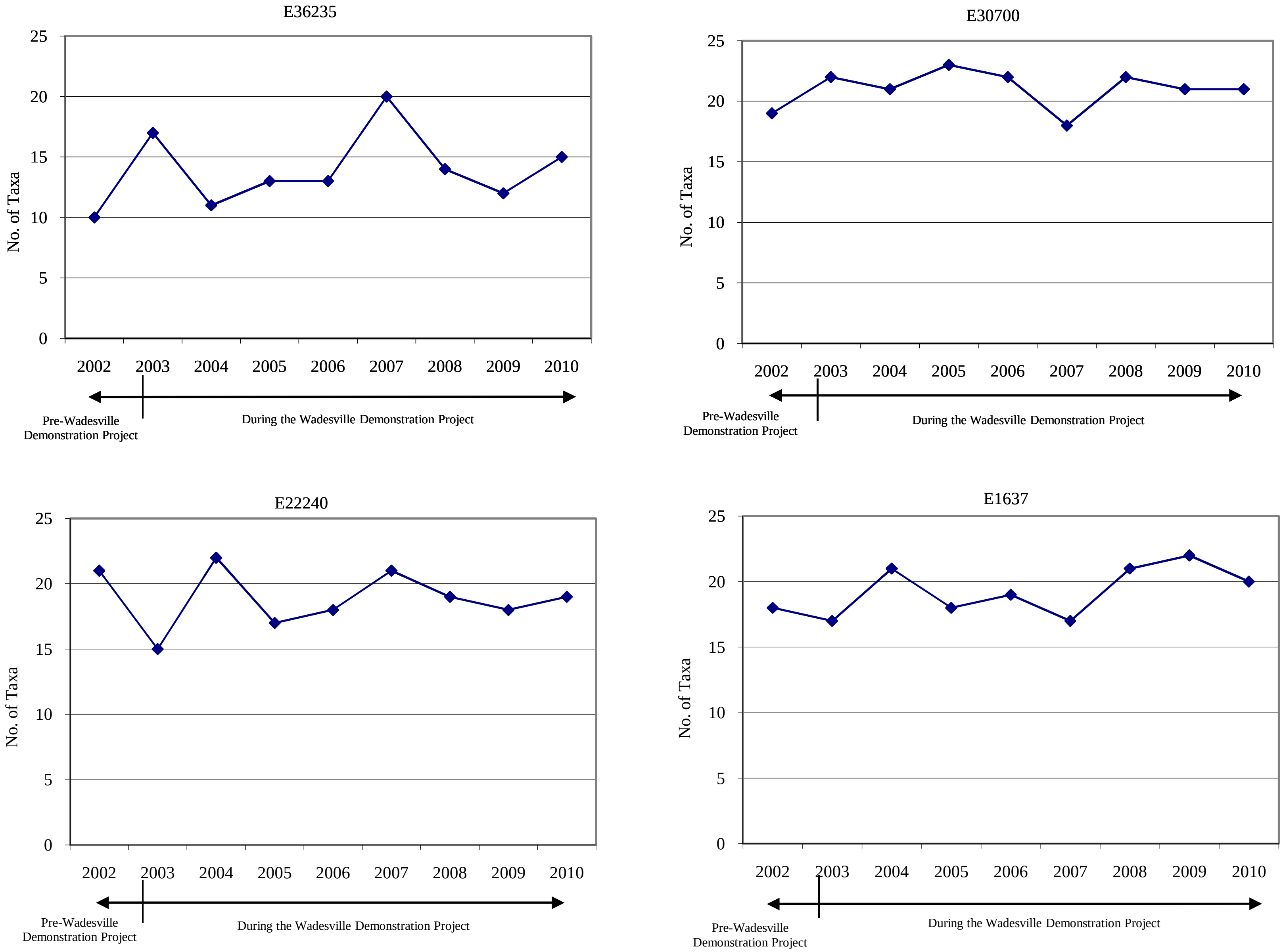

Figure 4.14-5. Total number of fish taxa collected at the four East Branch Perkiomen Creek stations, 2002-2010.

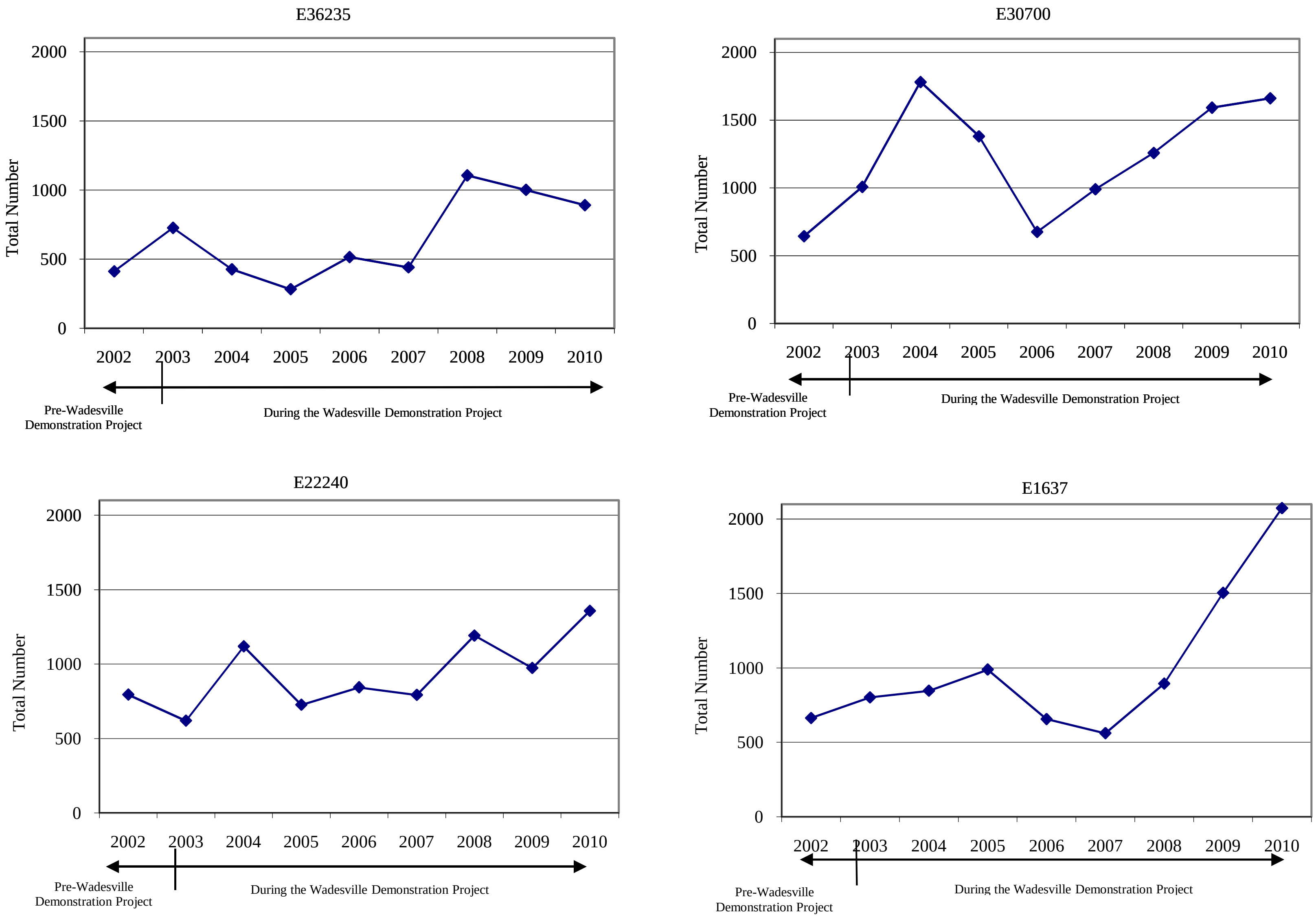

Figure 4.14-6. Total number of fish collected at the four stations on the East Branch Perkiomen Creek, 2002-2010.